



FIREPROOF HOUSES
of **NATCO** HOLLOW TILE and
HOW TO BUILD THEM





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CCA



FIREPROOF CONSTRUCTION

FOR HOUSES AND OTHER BUILDINGS OF MODERATE COST

FIFTH EDITION
Published JUNE 1911

NATIONAL FIRE PROOFING
COMPANY



ORGANIZED 1889

MANUFACTURERS OF
NATCO
HOLLOW TILE

THE LARGEST COMPANY IN THE WORLD DEVOTED
SOLELY TO THE BUSINESS OF FIREPROOF CONSTRUCTION

PITTSBURGH, FULTON BUILDING

CHICAGO, Commercial National Bank Building
CINCINNATI, Union Trust Building
CANTON, City National Bank Building
DETROIT, Penobscot Building
MINNEAPOLIS, Lumber Exchange
LOS ANGELES, Central Building

NEW YORK, Flatiron Building
PHILADELPHIA, Land Title Building
BOSTON, John Hancock Building
WASHINGTON, Colorado Building
COLUMBUS, Brunson Building
TORONTO, ONTARIO, Traders Bank Building

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1911

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CCA

Introduction to Fifth Edition.



CONCURRENTLY with four large editions of this book which have been exhausted in the past three years, has developed a new and far reaching trend in residence construction.

When, in 1908, the first edition was published, fireproof construction in residences of moderate cost amounted merely to a vague ideal.

Previously unobtainable details of construction, cost, etc., with reference to residences having outside walls, partitions, floors, foundations and roofs of fireproof Hollow Tile, were then first made available, and this opened the way to their practical application by architects and contractors.

Activity in the new form of residence building awakened at once, and made its influence felt throughout the East and spreading Westward. So satisfactory and superior did the results prove from the very first that never was the Hollow Tile house looked upon as a novelty, but attained without delay the highest recognition, not only as an advanced but as a thoroughly standardized practice.

Without the high repute gained by Hollow Tile in previous years for fireproofing the largest business and public structures, this rapid progress in Hollow Tile residence construction would, of course, have been impossible. It was not dealing in a material of unknown quantity and merit, but the application to a new use of the best proven of all fireproof materials.

So that the present edition of this book, the 5th, marks the arrival of fireproof Hollow Tile at a stage where it is invariably considered in comparison with frame, brick, concrete, etc., wherever well planned residences are contemplated. More and more it is coming to be preferred, as it is entitled to be, and it is now but a matter of a still further spread of knowledge in regard to it, to make fireproof Hollow Tile specifications the general rule for residences costing \$4,000 and upward.

As contractors have learned through actual experience the greater simplicity of setting Hollow Tile as compared with the more familiar practices, the newer material has also been enabled to compete successfully in the matter of building costs over an ever increasing area, so that now even in the West, where materials in general are comparatively much cheaper, Hollow Tile is gaining rapid popularity.

One of the most notable phases of the progress of Hollow Tile for residence work has been the steadily increasing number of architects who have built their own homes, using this material throughout. No stronger evidence could be submitted than this unqualified appreciation on the part of the very profession upon whose conclusions all building progress must depend.

Natco Hollow Tile.

From the earlier days of modern building, the National Fire Proofing Company has been entrusted with the Hollow Tile fireproofing of all the greater business and public structures, recent examples of which are the Singer Building, the Pennsylvania and Grand Central Terminals in New York, the enormous 22 story building of the Peoples Gas Company, the Chicago City Hall, the Chicago and Northwestern Terminal in Chicago, and other great structures built and now building on a similar scale.

It being entirely due to this Company that fireproof Hollow Tile has been made available for residence construction, it has been determined to stamp and identify the Tile, which is especially made and adapted for residence use. This Tile will be known as *NATCO HOLLOW TILE* and the word *NATCO* stamped on the outer side of each block will serve as reliable identification. This feature is important, as competing tiles have eagerly begun to bid for favor in the new field of residence construction, with the hope that they will encounter less stringent requirements of quality than those which have operated so strongly in favor of the National Fire Proofing Company in the larger forms of construction.

Two scientifically established facts express the principal points of *NATCO HOLLOW TILE* for residence construction, viz.:

1. Well burned clay cannot be destroyed by fire.
2. A dead air space is the best insulation against heat or cold and consequently the best protection against the destructiveness of high temperatures as generated in burning buildings.

It is worth while for both architect and owner to bear in mind that the kind of buildings herein illustrated and described are not only Fire Resisting, but are of

ENDURING MASONRY CONSTRUCTION THROUGHOUT.

That by reason of the indestructibility of the material and their substantial construction these houses

COST FAR LESS FOR MAINTENANCE AND REPAIRS

than in the case with buildings of frame or brick-and-wood.

Floors of wooden joist construction warp and crack. Floors of Fireproof Hollow Tile endure for all time.

Exteriors of frame houses must be painted frequently, walls of Cement Coated Natco Hollow Tile, never.

Stucco applied over expanded metal has never proven satisfactory. Dampness will invariably work through and will cause the wood studs and siding to expand and settle. This will cause unsightly cracks to appear in the wall.

This difficulty has been eliminated by the use of Hollow Tile, which not only forms an ideal bond with the stucco, but furnishes a masonry wall which cannot settle.

Walls of wood or brick absorb, retain and carry to the interior of the house the frosts of Winter and the heat of Summer. The air space in walls of Natco Hollow Tile furnishes complete insulation against atmospheric conditions, thereby reducing the cost of heating to a minimum, and buildings of this material compared with brick, frame, stone, concrete or a combination of all four are

WARMER IN WINTER—COOLER IN SUMMER.

Houses with walls of brick, concrete or frame, and furred with wood, carry sound and vibration, and are subject to the penetration and ravages of vermin. Natco Hollow Tile Houses require no furring and are

MOISTURE PROOF—SOUND PROOF—VERMIN PROOF.

When it is considered that a residence with all these advantages and completely Fireproof can be built at as low cost as one of brick, brick-and-wood, stone-and-wood, or concrete, and comparing favorably with frame, can there be any hesitation in adopting this modern method of construction?

In considering the illustrations and plans in this book it should be noted that they are simply types and examples of what has been and can be accomplished with Natco Hollow Tile, and the methods of construction in use to achieve these results.

A house of any desired size or architectural appearance may be built on the general ideas advanced herein. These ideas are offered as an aid to the architect in formulating plans for small buildings of substantial fire proof construction and any architect can readily adapt these principles to any building which he may be planning.

It will be seen that structural steel, which forms such a great item of cost in large, standard fireproof buildings, is entirely eliminated in buildings of the type considered in this work. The only manner in which steel is used at all in these buildings, is in the shape of small tension members for reinforcing purposes.

It is this elimination of structural steel and the simplicity of Hollow Tile construction which makes it possible to build an enduring masonry residence fireproof throughout, within the limits of cost established by the average financial resources.

While *NATCO HOLLOW TILE* has been treated in this introduction with more or less special reference to *residence construction*, the scope of this term must be broadened in the reader's mind to include all smaller forms of building—in other words, wherever the construction contemplates *outside walls of Hollow Tile*. Properly under the head are not only residences, but school-houses, apartment houses, hotels, factories, garages, stores, stables, and other buildings for special purposes which would formerly be planned of frame, brick or concrete.

NATIONAL FIRE-PROOFING · COMPANY ·

ORGANIZED 1889



Residence at Hohokus, New Jersey.

Kenneth M. Murchison, New York, Architect.

This is a thoroughly fireproof house, the walls, floors and bearing partitions being constructed of Hollow Tile, while the roof is slate. The walls and floors are of 8 inch Natco Hollow Tile. The walls are not furred, but are waterproofed on the inside of the Tile, while the outside finish is of white asbestos stucco. The foundations are concrete. The main part of the house measures 32 ft. 6 inches by 60 ft., while the wing measures 21 ft. by 42 ft. 6 inches. The house contains 17 rooms and 5 bathrooms, and also has a sleeping porch off the second floor.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1913



Residence at Orange, New Jersey.

Mann & MacNeille, New York, Architects.

This is one of a group of houses put up by a prominent building firm for the purpose of speculation, and no expense has been spared, even down to the smallest detail, to make the houses as attractive, and at the same time thoroughly substantial, as is possible to be done under modern building conditions. The fact that all of the houses in this group are fireproof in every sense of the word, is one of the most important talking points that the builders have to offer, when dealing with prospective customers.

The walls, floors and partitions are all constructed of Hollow Tile, 8 inch Natco Hollow Tile being used for the first story walls and 6 inch Tile for the second. The foundations are concrete. The walls are not furred, and are covered with white stucco, in which is mixed a waterproof composition. The house measures 28 ft. by 35 ft., and contains 10 rooms and one bathroom.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING · COMPANY ·



BRIDGEVILLE, PA.



Residence at Water Witch, New Jersey.

Ford, Stewart & Oliver, New York, Architects.

The first story walls of this house are constructed of 12 inch Natco Hollow Tile and the above stories of 8 inch Tile. The foundations are also constructed of Natco Hollow Tile, thereby insuring an absolutely dry and vermin proof cellar. The floors are wood and the roof slate. The walls are waterproofed both inside and out, and are finished with cream white asbestos stucco. The house has hot air heat and electric light throughout.

NATCO HOLLOW TILE

NATIONAL FIRE-PROOFING COMPANY



ORGANIZED 1888



Residence at South Orange, New Jersey.

David M. Ach, New York, Architect.

This is a thoroughly fireproof house throughout, the walls, floors and partitions being constructed of Hollow Tile, while the roof is of slate. The walls are built of 8 inch Natco Hollow Tile and the floors of 6 inch Tile. The foundations are concrete. The walls are finished with gray stucco and are not furred, but are waterproof on the outside of the Tile. The house has steam heat, gas and electric light throughout.

NATCO-HOLLOW-TILE

NATIONAL FIRE PROOFING COMPANY



INCORPORATED 1888



Residence at Cobourg, Canada.

W. J. Carpenter, Beaver, Pa., Architect.

This is another example of the far reaching effect of the use of Natco Hollow Tile.

The outside walls of this house were constructed of 8 and 12 inch Natco Hollow Tile. The partitions are also of Hollow Tile. The foundations are concrete, the floors wood and the roof green slate. The exterior is a rough cast stucco finish. The house measures 140 ft. by 142 ft. and forms an interior court, in which is a sunken garden, and upon which several first and second story rooms open. The first floor consists of 10 rooms and the second floor of 14 rooms and 8 bathrooms. The third floor is used for servants' accommodations. This residence was completed and occupied nine months after the contract was awarded, due in a large measure to the simplicity of construction, where Hollow Tile is used.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1889



Residence at Rosslyn Farms, Pennsylvania.

W. H. Parish, Pittsburgh, Architect and Owner.

This is another example where an architect has selected Natco Hollow Tile for his own home, and we believe this to be the strongest endorsement obtainable of the growing popularity of this material for house construction.

The walls and foundations are constructed of 8 inch Natco Hollow Tile. The floors are wood and the roof a fireproof composition. The outside finish is a light gray and the first floor is finished in hardwood. The house has 7 rooms and one bathroom, and is an exceptionally good example of a low priced Natco Hollow Tile residence.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1888



Residence at Madison, New Jersey.

Freeman & Hasselman, New York, Architects.

This is a striking example of Natco Hollow Tile walls with brick facing, as illustrated in detail on page 74.

The first story walls of this house are constructed of 12 inch Natco Hollow Tile and the second story walls of 8 inch Tile. The floors are reinforced concrete, the foundations stone and the roof slate. The walls are furred, and are finished with a veneer of Harvard brick, with limestone trim, tied to the wall with iron anchors. The house has steam heat, gas and electric light throughout.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



Residence at Rose Valley, Pennsylvania.

Walter F. Price, Philadelphia, Architect.

This style of bungalow is one which will appeal at once to all who are contemplating building a moderate priced fireproof dwelling in the country. The walls are constructed of 4 inch Natco Hollow Tile, cement rough cast on the exterior, and plastered direct on the interior. The foundations are concrete, the stairs and floors reinforced concrete and the roof Spanish Tile. The house has 7 rooms and one bathroom, with hot water heat throughout.

The cost complete, as given by the Architect, was \$2,500.00.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1888



Residence at Chestnut Hill, Pennsylvania.

Wilson Eyre Jr., Philadelphia, Architect.

This house is thoroughly fire proof in every way, the walls, floors and roof construction all being of Hollow Tile, as well as the stable and garage, which is illustrated on page 66. The walls are constructed of 12 inch Natco Hollow Tile. The floor construction is the Combination floor, which is the same system that is used successfully in a great many larger structures, such as office buildings and factories. The foundations are stone and the outside roof heavy slate. The interior construction of the roof, however, is of Natco Hollow Tile. The outside finish is white, and the walls are neither furred nor waterproofed.

The house has 27 rooms and 10 bathrooms, and has hot water heat, gas and electric light throughout.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1884



Residence at Orange, New Jersey.

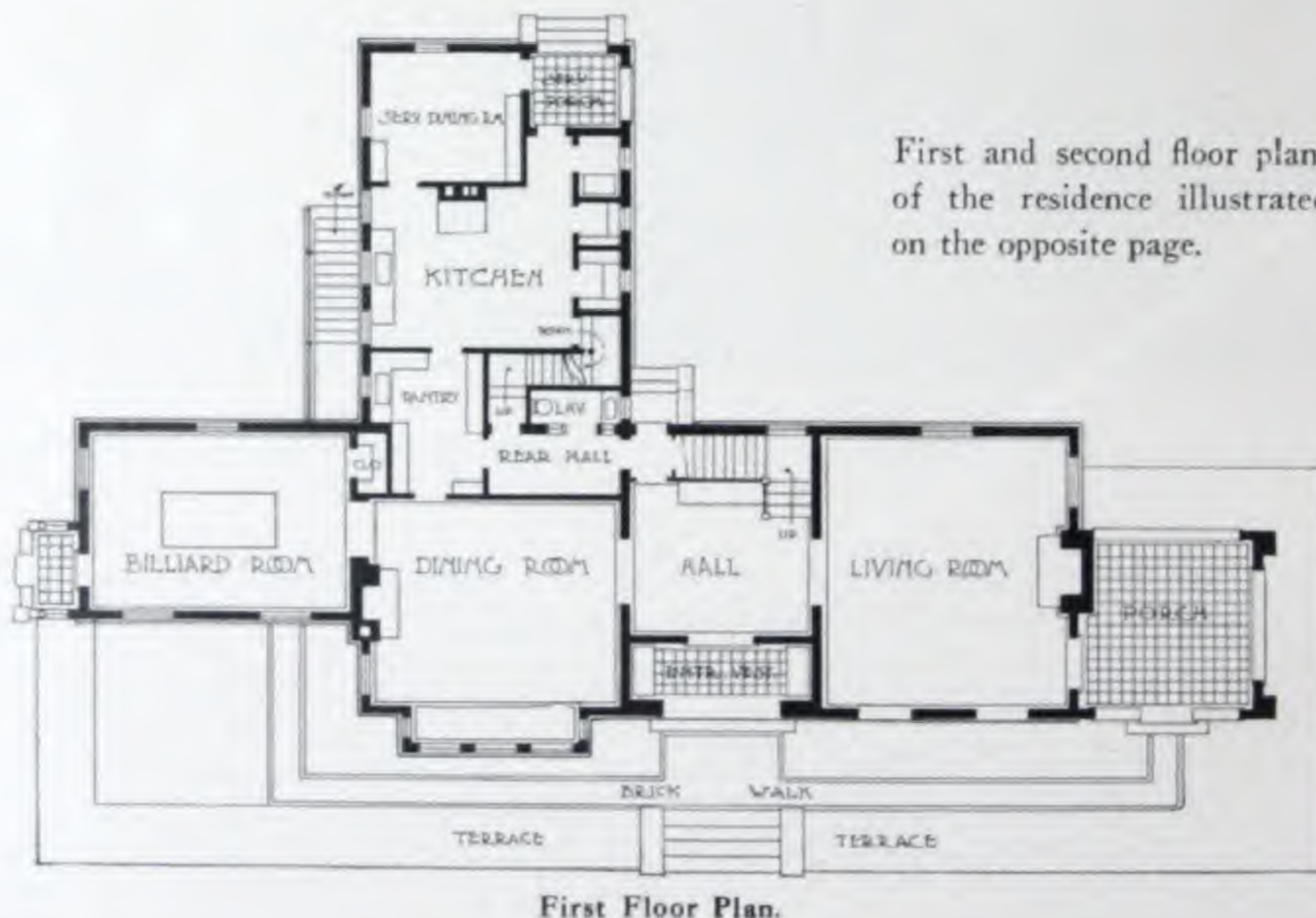
Mann & MacNeille, New York, Architects.

This is another one of a group of houses put up by a prominent building firm for the purpose of speculation, the first of which is illustrated on page 8.

The house is thoroughly fireproof throughout. The walls to the second story level are constructed of 8 inch Natco Hollow Tile set on poured concrete foundations. The walls above to the roof plate are 6 inch Tile. The floors and partitions are also constructed of Hollow Tile. The roof is gray slate carried on wooden timbers. The outside finish is a gray stucco. The house has 11 rooms and one bathroom, and has hot air heat and electric light throughout. The total floor space is 1200 square feet.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



First and second floor plans
of the residence illustrated
on the opposite page.

NATCO-HOLLOW-TILE

NATIONAL FIRE-PROOFING - COMPANY -



INCORPORATED 1909



Residence at Englewood, New Jersey.

Mann & MacNeille, New York, Architects.

This house is of the Italian villa style of architecture, which seems particularly adaptable for residences where the outside walls are built of Hollow Tile.

The first floor walls are constructed of 8 inch Natco Hollow Tile, while 6 inch Tile were used in the second floor walls. The outside finish is of white stucco, which produces a very pleasing effect, when employed in this particular style of architecture. The floors are wood and the roof shingle.

The house stands out against a background of trees, and in the planning, advantage has been taken of the building facing South, to let all the principal rooms have a Southern exposure. There is also a second story sleeping balcony facing the South.

NATCO-HOLLOW-TILE

NATIONAL FIRE PROOFING · COMPANY ·



ORGANIZED 1887



Residence at Oak Park, Illinois.

Frank Demoney, Chicago, Architect.

This is a thoroughly fireproof house throughout, and is one of the best examples obtainable of a moderate priced fireproof residence that has been built in this section of the country.

The walls are constructed of 8 inch Natco Hollow Tile set on concrete foundations. The floors are the Johnson system, detail of which is shown on page 79. The partitions are all Hollow Tile and the roof is slate. The outside stucco finish is old rose, and the roof is colored sea green. The house has 8 rooms and one bathroom.

NATCO · HOLLOW · TILE

NATIONAL FIRE-PROOFING
· COMPANY ·



Residence at Oak Park, Illinois.

Frank Demoney, Chicago, Architect.

The above illustration is the same house as shown on the opposite page, before the stucco has been applied to the Natco Hollow Tile walls. There are any number of different finishes obtainable when the stucco is applied, a few of which are illustrated on page 71.

NATCO·HOLLOW·TILE

NATIONAL FIRE-PROOFING · COMPANY ·



ESTABLISHED 1899



Residence at Los Angeles, California.

Alban H. Reeves, Los Angeles, Architect.

This is another example of the far reaching effect of the use of Natco Hollow Tile for residence construction. The walls are constructed of two thicknesses of 6 inch Natco Hollow Tile with 3 inch space between, making a 15 inch wall. The floors are wood and the roof is red tile.

NATCO·HOLLOW·TILE

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Residence at Spuyten Duyvil, New York.

Robert W. Gardner, New York, Architect.

This type of house is one which will at once appeal to the average prospective home builder as being delightfully simple and attractive. Its fireproof qualities, however, are just as lasting as any of the more pretentious dwellings which have been illustrated. The first story walls are constructed of 10 inch Natco Hollow Tile, while 8 inch Tile were used in the second story walls. The roof is of red tile, and the house contains 7 rooms and bath and has hot water heating and electric light throughout. The walls are finished with gray stucco and are neither furred nor waterproofed. This is an excellent example of a moderate priced fireproof house.

NATCO-HOLLOW-TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1899



Residence at Mt. Vernon, New York.

S. A. Guttenberg, Mt. Vernon, N. Y., Architect.

The above illustration shows the condition of the house before the stucco has been applied to the Natco Hollow Tile. The walls of this house are constructed of 10 inch Natco Hollow Tile and are neither furred nor waterproofed. The floors are wood, the foundations stone and the roof Spanish tile. The outside finish will be light gray stucco trimmed with white. The house measures 64 ft. by 70 ft., and contains 20 rooms, 4 bathrooms and 4 lavatories. There is an indirect heating system, and gas and electric light throughout.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1898



Residence at South Orange, New Jersey.

Squires & Wynkoop, New York, Architects.

This is a thoroughly fireproof house, the walls, floors and partitions being constructed of Hollow Tile. The walls and floors are of 8 inch Natco Hollow Tile, and the partitions are of 3 and 8 inch Tile. The walls are finished with gray stucco, and are waterproofed but not furred. The roof is asbestos shingle. The house contains 10 rooms and 2 bathrooms, and has hot air heat and electric light throughout.

NATCO·HOLLOW·TILE

NATIONAL FIRE-PROOFING · COMPANY ·



ORGANIZED 1898



Residence at Ardsley-on-Hudson, New York.

Robert W. Gardner, New York, Architect.

This house is thoroughly fireproof throughout, the walls, floors and partitions being constructed of Hollow Tile. The walls are of 8 inch Natco Hollow Tile, finished with white stucco, and are neither furred nor waterproofed. The floor construction is the Combination floor, consisting of 6 inch Natco Tile, with $\frac{1}{2}$ inch steel rods used for 12 and 18 ft. spans.

The main part of the house is 34 ft. by 58 ft., and the extension is 20 ft. by 26 ft. 8 inches, containing 18 rooms and 3 bathrooms in all. There is hot water heating and electric light throughout.

This house was not built by a specialist in any form of construction, but by a New York builder, schooled in the old ways, who has found the new ones easy. The stable illustrated on page 66 was also constructed of Natco Hollow Tile.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING COMPANY



GREENWICH, N.Y.



Residence at Clifton, Pennsylvania.

Alexander M. Adams, Philadelphia, Architect.

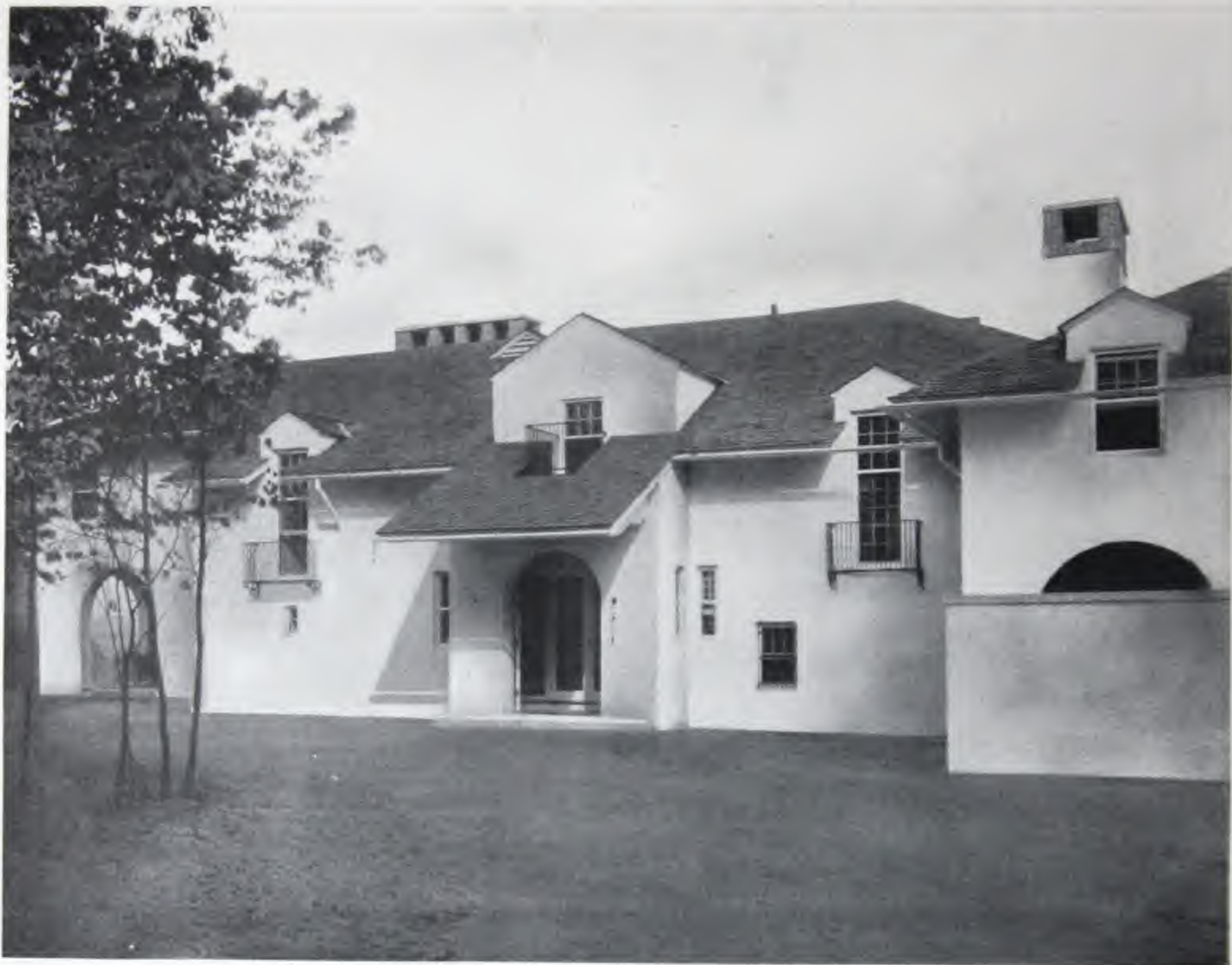
This is a striking example of the adaptability of Natco Hollow Tile for residence construction. The walls from the second story up are constructed of 8 inch Natco Hollow Tile and the foundation and first story are of stone. The floors are wood and the roof slate. The tile is covered with white stucco, which gives a very pleasing effect when used with the white stone. The house has 11 rooms and one bathroom.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING · COMPANY ·



ORGANIZED 1907



Residence at Sewickley, Pennsylvania.

Janssen & Abbott, Pittsburgh, Architects.

This house is of the Italian country style of architecture, which is especially noted for its simplicity of design. The walls are constructed of 12 inch Natco Hollow Tile and the foundations are also of 12 inch Tile, thereby insuring a perfectly dry and vermin proof cellar. The floors are wood and the roof shingle. The outside finish is plain white. The house has 10 rooms and 3 bathrooms, and is an especially good example of a well planned and well built country home.

NATCO · HOLLOW · TILE

NATIONAL FIRE PROOFING
COMPANY



Residence at Orange, New Jersey.

Mann & MacNeille, New York, Architects.

This is another one of a group of houses put up by a prominent building firm for the purpose of speculation, the first of which is illustrated on page 8.

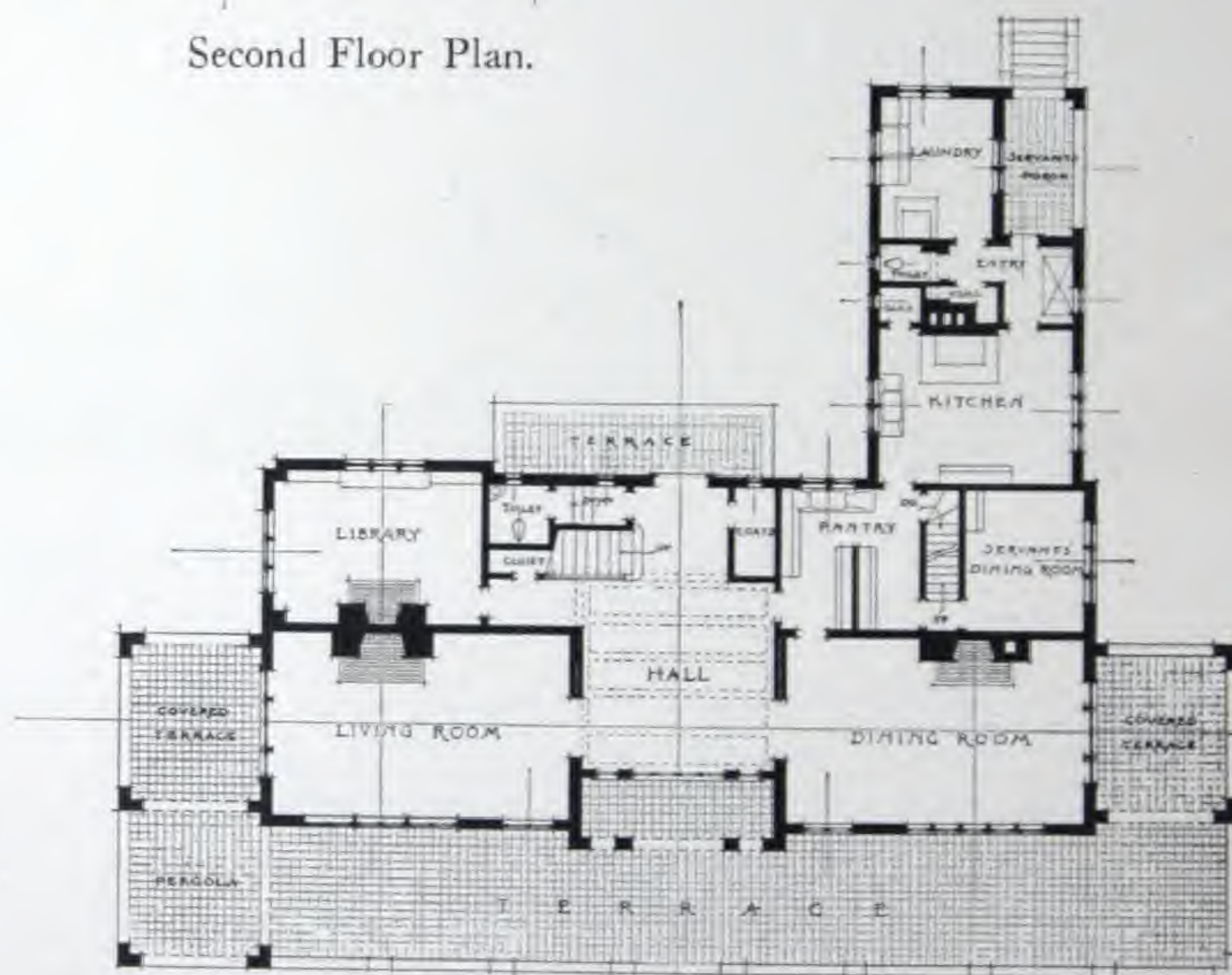
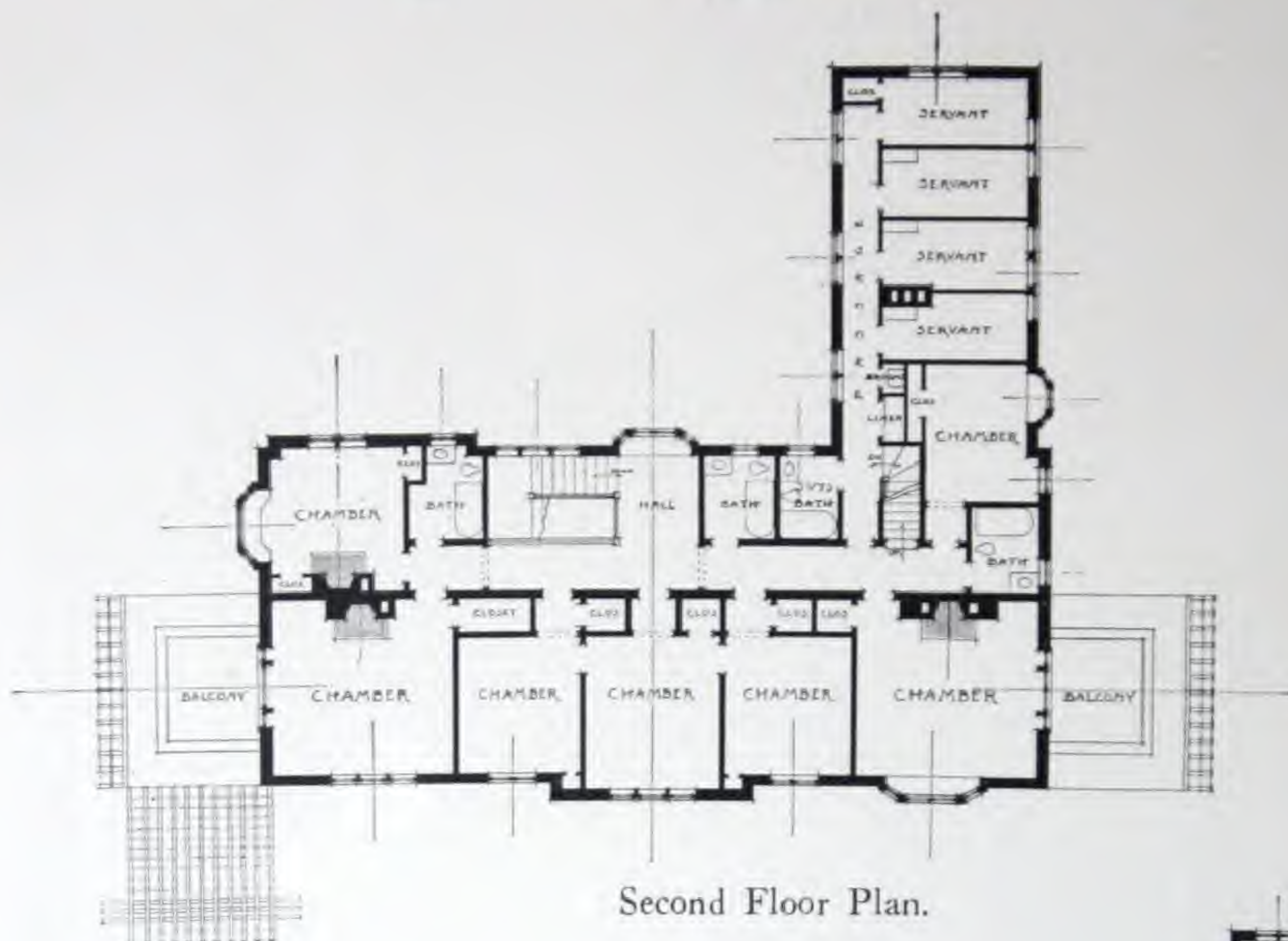
The house is thoroughly fireproof throughout. The walls to the second story level are constructed of 8 inch Natco Hollow Tile set on poured concrete foundations. The walls above to the roof plate are of 6 inch Tile. The floors and partitions are also constructed of Hollow Tile. The roof is green and purple slate, carried on wooden timbers. The outside is a dark cement finish, obtained by the addition of lamp black to the mixture. The house has hot air heat and electric light throughout.

NATCO HOLLOW TILE

NATIONAL FIRE-PROOFING · COMPANY ·



ORGANIZED 1887



First and second floor plans of the residence illustrated on the opposite page.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING COMPANY



Residence at Brielle, New Jersey.

Edward Shepard Hewitt, New York, Architect.

The walls of this house are constructed of 8 inch Natco Hollow Tile, and are neither furred nor waterproofed. The terrace extending across the front of the house is of red vitrified brick, and the exterior finish on the walls is white stucco. The floors are wood, the foundations concrete and the roof green slate. The house has steam heat and electric light throughout.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1887



Residence at Sands Point, Long Island.

Foster, Gade & Graham, New York, Architects.

This is one of the most complete fireproof houses in existence to-day, the walls, floors and partitions are all constructed of Hollow Tile, while the roof is of Spanish tile. The first story walls are constructed of two 6 inch Natco Hollow Tile, making a 12 inch double wall, while the upper story walls are 6 and 4 inch Tile, making a 10 inch double wall. The foundations are concrete. The wall blocks are tied together with metal wall ties. The walls are neither furred nor waterproofed and are finished with rough white stucco. The house is 53 ft. by 116 ft. and contains 26 rooms and 6 bathrooms.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING
COMPANY
ORGANIZED 1897



Bungalow at Morsemere, New Jersey. Geo. A. Roff, Palisade Park, N. J., Owner and Designer.

The walls of this bungalow are constructed of 8 inch Natco Hollow Tile, and are neither furred nor waterproofed. The outside finish is of white stucco, while the exterior trim of the bungalow is of grass-green color. The foundations are stone and the roof rubberoid. There are 12 rooms, 2 bathrooms and 3 lavatories, with hot water heating, gas and electric light throughout.

NATCO HOLLOW TILE

NATIONAL FIRE-PROOFING COMPANY



Residence at Montclair, New Jersey.

W. Leslie Walker, New York, Architect and Owner.

This is another example of where an architect has selected Natco Hollow Tile for use in his own house, and we believe this to be the strongest endorsement obtainable of the growing popularity of this material for residence construction. This is a thoroughly fireproof house, the walls, floors and partitions being constructed of Hollow Tile. The walls are of 8 inch Natco Hollow Tile set on concrete foundations. The roof is red tile. The outside finish is cream stucco and no waterproofing has been used. The house measures 36 ft. by 60 ft. and has 11 rooms, 2 bathrooms and a conservatory.

NATCO HOLLOW TILE

NATIONAL FIRE-PROOFING
· COMPANY ·
ORGANIZED 1888



Residence at South Orange, New Jersey.

Squires & Wynkoop, New York, Architects.

The first story walls of this house are constructed of 10 inch Natco Hollow Tile, while 8 inch tile is used in the second story walls. The walls are neither furred nor waterproofed. The outside finish is a rough pebble dash gray stucco.

The floors are wood, the foundations concrete and the roof slate. The house has hot water heat and electric light throughout.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING
COMPANY
ORGANIZED 1891



Residence at Edgeworth, Pennsylvania.

Charles Barton Keen, Philadelphia, Architect.

The walls of this house are constructed of 10 inch Natco Hollow Tile. The floors are wood.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



Residence at Glencoe, Illinois.

Lowe & Ingram, Chicago, Architects.

The walls of this house are constructed of 8 inch Natco Hollow Tile. The foundations are also constructed of Natco Hollow Tile, thereby insuring a thoroughly dry and vermin proof cellar. The floors are wood and the roof shingle.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING
COMPANY
ORGANIZED 1888



Residence at West Roxbury, Massachusetts.

O. A. Thayer, Boston, Architect.

The outside walls of this house are constructed of 10 inch Natco Hollow Tile.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING
COMPANY
ORGANIZED 1888



Residence at Chevy Chase, Maryland.

Michael Heister, Washington, Architect and Owner.

This is another example of where an architect has selected Natco Hollow Tile for his own home, and we believe this to be the strongest endorsement that we can offer of the growing popularity of this material for house construction.

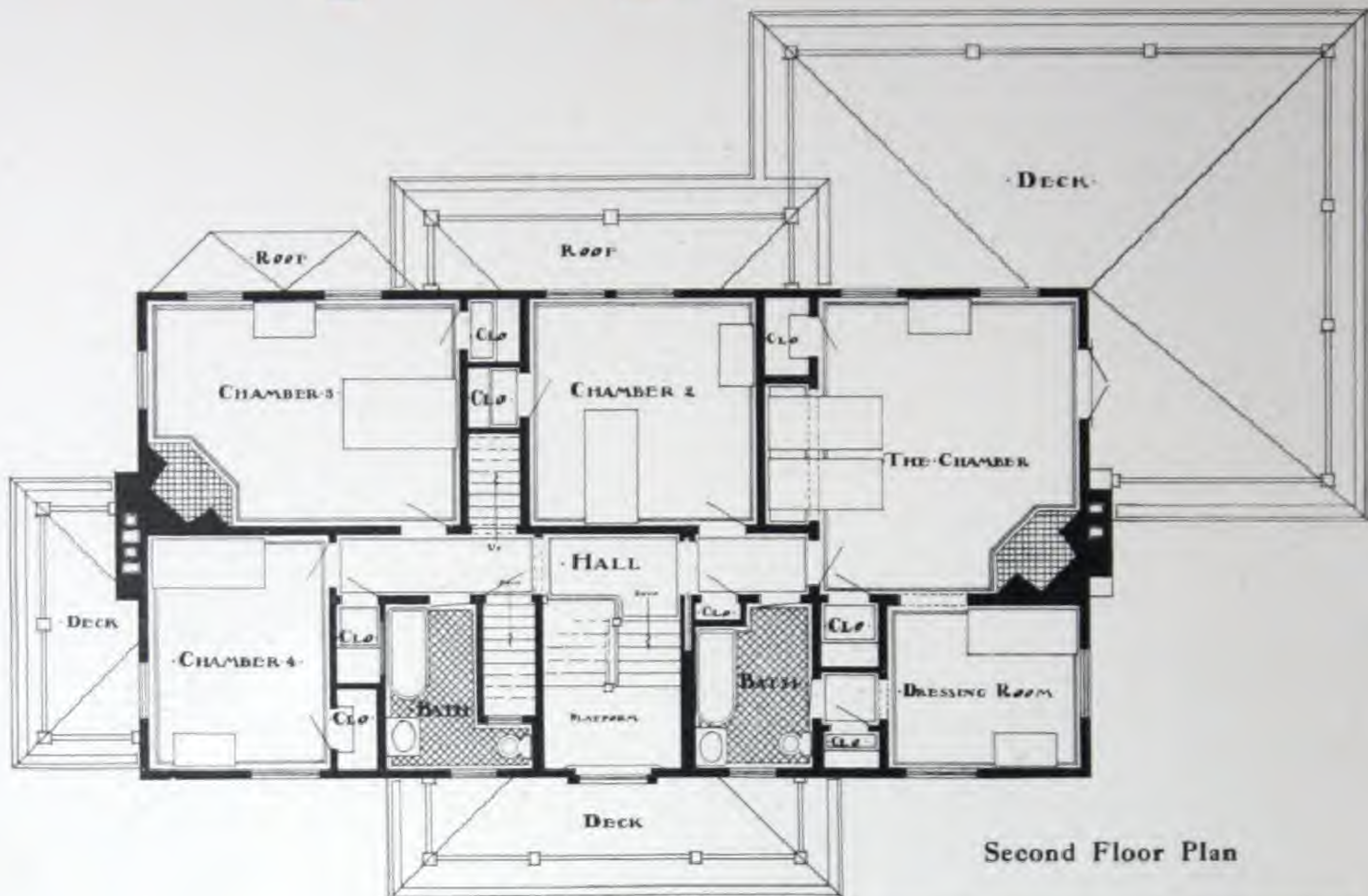
The walls are constructed of Natco Hollow Tile set on concrete foundations. The floors are wood and the roof red tile. The house has 14 rooms and 2 bathrooms. The living room in this house is 15 ft. 6 inches by 31 ft. 6 inches, and directly beneath this room in the basement is a Rathskeller of the same size.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1888



First and second floor plans of the residence illustrated on the opposite page.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING
COMPANY
ORGANIZED 1882



Residence at Dongan Hills, New York.

Henry Atterbury Smith, New York, Architect.

The walls of this house are constructed of 8 inch Natco Hollow Tile, and are not furred, but are waterproofed on the outside of the stucco, which is of grayish color. The foundations are brick, the floors wood and the roof shingle. The house measures 28 ft. by 54 ft. and has 14 rooms and 3 bathrooms.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING · COMPANY ·



ORGANIZED 1888



Residence at Chatham, New Jersey.

Richard S. Shapter, Summit, New Jersey, Architect.

The first story walls of this house are constructed of 10 inch Natco Hollow Tile, while 8 inch Tile has been used for the above stories. The walls are finished with cream colored stucco, and are not furred, but are waterproofed inside the Tile and outside the stucco. The floors are wood, the foundations stone and the roof Spanish tile. The house measures 38 ft. by 56 ft., and contains 11 rooms and 4 bathrooms.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1889



Residence at Port Chester, New York.

Harry F. Mertz, Port Chester, Owner and Designer.

This is a thoroughly fireproof house throughout, the walls, floors and partitions being constructed of Hollow Tile and the roof also being tile. The walls are of 8 inch Natco Hollow Tile, the floors of 6 inch Tile and the partitions of 3 and 4 inch Tile. The walls are neither furred nor waterproofed and are covered with white rough cast stucco. The foundations are stone. The house measures 30 ft. by 33 ft., and contains 11 rooms and 1 bathroom.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING · COMPANY ·



ORGANIZED 1889



Residence at Orange, New Jersey.

Dillon, McClellan & Beadel, New York, Architects.

The walls of this house are constructed of 8 inch Natco Hollow Tile, and are neither furred nor waterproofed. The outside is a light buff stucco, stippled finish, which is not only pleasing to the eye, but gives a thoroughly strong and substantial finish from every point of view. The floors are wood, the foundations concrete and the roof shingle. The house has hot air heat and electric light throughout.

NATCO · HOLLOW · TILE

NATIONAL FIRE PROOFING
• COMPANY •
ORGANIZED 1909



Residence at Orange, New Jersey.

Mann & MacNeille, New York, Architects.

This is another one of a group of houses put up by a prominent building firm for the purpose of speculation, the first of which is illustrated on page 8.

The house is thoroughly fireproof throughout. The walls to the second story level are constructed of 8 inch Natco Hollow Tile set on poured concrete foundations. The walls above to the roof plate are of 6 inch Tile. The floors and partitions are also constructed of Hollow Tile. The roof is green tile. The outside finish is a buff stucco. The house has 11 rooms and 1 bathroom, and has hot air heat and electric light throughout. The total floor space is 1200 square feet.

NATCO HOLLOW TILE

NATIONAL FIRE-PROOFING · COMPANY ·



ORGANIZED 1888



Residence at Maplewood, New Jersey.

Freeman & Hasselman, New York, Architects.

This is a thoroughly fireproof house in every sense of the word, the walls, foundations, floors and partitions being constructed of Hollow Tile, while the roof is black slate. The foundations are of 12 inch Natco Hollow Tile, thereby insuring an absolutely dry and vermin proof cellar. The first story walls are of 10 inch Natco Hollow Tile and the above stories of 8 inch Tile. The partitions and floors are also constructed of Hollow Tile. The house measures 34 ft. by 36 ft., has 11 rooms and 2 bathrooms and steam heat throughout.

NATCO·HOLLOW·TILE

NATIONAL FIRE-PROOFING
· COMPANY ·
ORGANIZED 1889



Residence at South Orange, New Jersey.

Rossiter & Wright, New York, Architects.

This is a fireproof house throughout, the walls, floors and partitions being constructed of Hollow Tile. The walls are of 8 inch Natco Hollow Tile and are not furred. The outside finish is red stucco in which a waterproofing material is mixed. The roof is asbestos shingle. The house measures 28 ft. by 42 ft., and has 13 rooms and 2 bathrooms.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING COMPANY



INCORPORATED 1888



Residence at Lancaster, Pennsylvania.

Wm. C. Prichett, Philadelphia, Architect.

The first story walls of this house are constructed of 12 inch Natco Hollow Tile, while 10 inch Tile was used in the above stories. The foundations are stone, the floors wood and the roof tile. The outside stucco finish is light cream. The house has 20 rooms and 5 bathrooms, and has hot air heat and gas and electric light throughout. An especially attractive feature about this house is the outside terrace, which is paved with brick and tile.

NATCO HOLLOW TILE

NATIONAL FIRE-PROOFING COMPANY



ORGANIZED 1888



Residence at Orange, New Jersey.

Mann & MacNeille, New York, Architects.

This is another one of a group of houses put up by a prominent building firm for the purpose of speculation, the first of which is illustrated on page 8.

The house is thoroughly fireproof throughout. The walls to the second story level are constructed of 8 inch Natco Hollow Tile set on poured concrete foundations. The walls above to the roof plate are of 6 inch Tile. The floors and partitions are also constructed of Hollow Tile. The roof is gray slate carried on wooden timbers. The outside finish is a buff stucco. The house has 10 rooms and 1 bathroom, and has hot air heat and electric light throughout. The total floor space is 1050 square feet.

NATCO-HOLLOW-TILE

NATIONAL FIRE PROOFING · COMPANY ·



ORGANIZED 1888



Residence at South Orange, New Jersey.

Rossiter & Wright, New York, Architects.

This is a thoroughly fireproof house, the walls, floors and partitions being constructed of Hollow Tile. The walls are of 8 inch Natco Hollow Tile, and are not furred. They are finished with stucco in which is mixed a waterproofing material. The roof is asbestos shingle. The house measures 28 ft. by 42 ft., and contains 13 rooms and 2 bathrooms.

NATCO · HOLLOW · TILE

NATIONAL FIRE-PROOFING COMPANY



INCORPORATED 1914



Residence at Westfield, New Jersey. Hollingsworth & Bragdon, Cranford, New Jersey, Architects.

The walls of this house are constructed of 8 inch Natco Hollow Tile, covered with gray stucco, and are neither furred nor waterproofed. The floors are wood, the foundations concrete and the roof shingle. The house contains 10 rooms and 3 bathrooms, and has hot air heating and electric light throughout.

NATCO-HOLLOW-TILE

NATIONAL FIRE-PROOFING · COMPANY ·



ORGANIZED 1888



Residence at Glen Ridge, New Jersey.

F. A. Wright, New York, Architect.

This is a thoroughly fireproof house, the foundations, walls and floors being constructed of Hollow Tile, while the roof has asbestos shingles. The foundations are of 12 inch Natco Hollow Tile, thereby insuring an absolutely dry and vermin proof cellar. The walls are of 8 inch Natco Hollow Tile and the floors of 6 inch tile. The house measures 53 ft. by 68 ft., and has 10 rooms and 2 bathrooms.

NATCO·HOLLOW·TILE

NATIONAL FIRE-PROOFING COMPANY



ORGANIZED 1889



The walls are constructed of 12 inch Natco Hollow Tile set on concrete foundations. They are neither furred nor waterproofed, and finished with white stucco. The floors are reinforced concrete, finished in Welsh quarry tile and the roof Spanish tile. The Pergola is wood. The first floor is electric lighted, and has eight dressing rooms, each having a shower bath,

washroom, pantry and large rotunda from which a staircase leads to the pavilion above. The building measures 36 ft. by 36 ft.

Bathing Pavilion at Glen Cove, Long Island.

C. P. H. Gilbert, New York, Architect.

Pump House and Servants' Bathing Pavilion.

The construction of this building is the same as the one shown above. It measures 26 ft. 6 inches by 31 ft. 6 inches and contains a living room and bedroom for men, nine dressing rooms and two showers for servants, and a pump room.

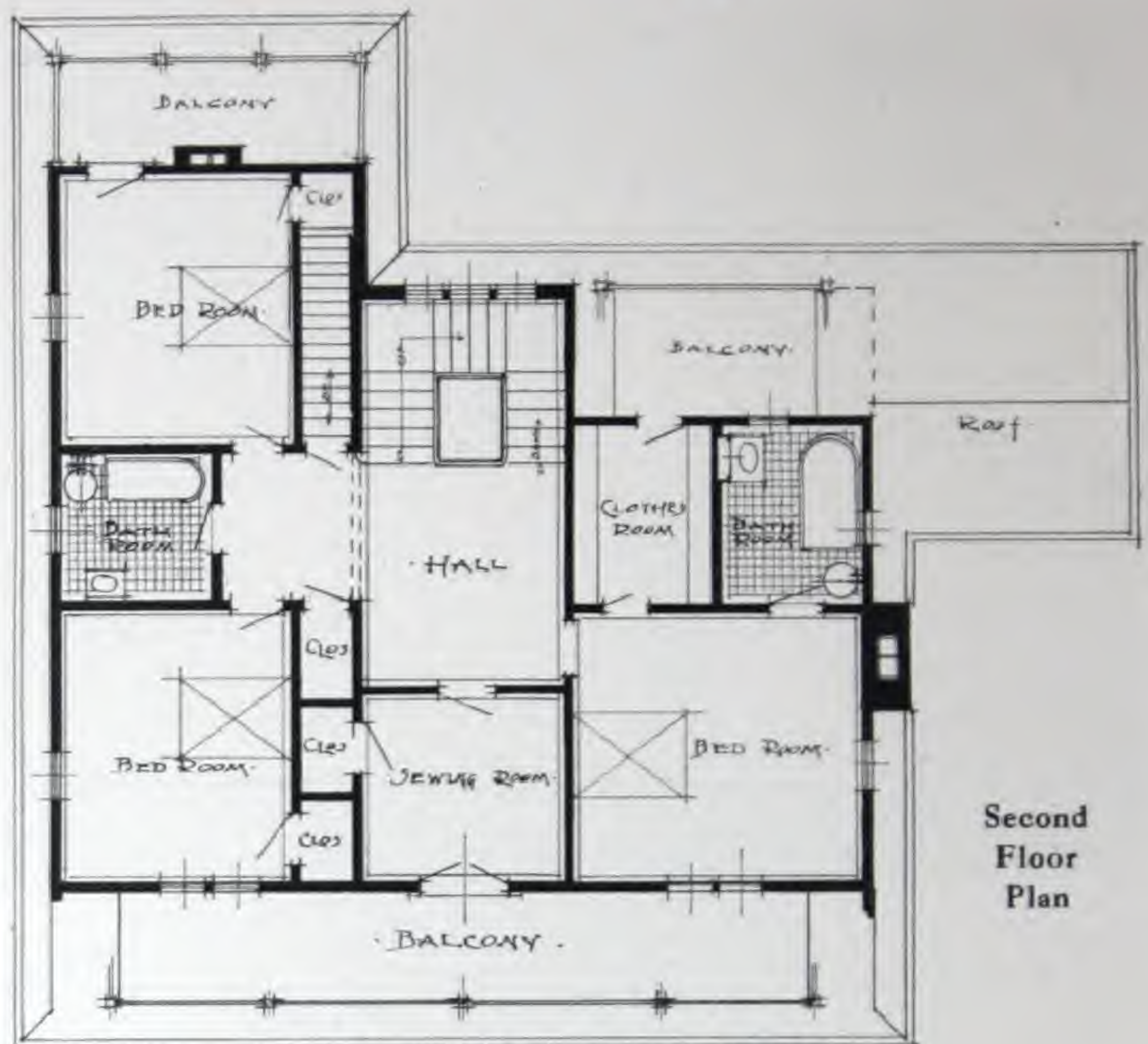


NATCO-HOLLOW-TILE

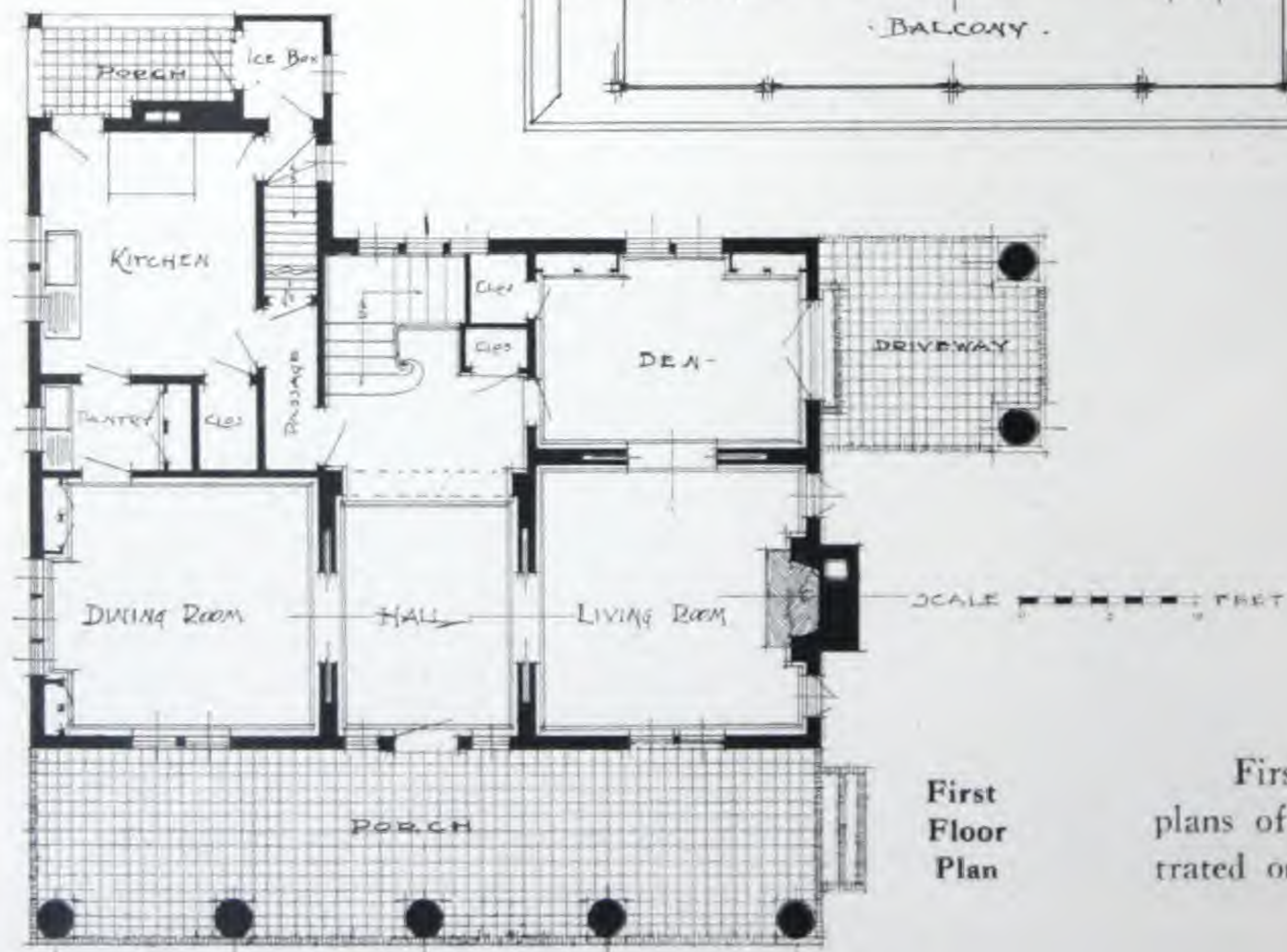
NATIONAL FIRE PROOFING · COMPANY ·



ORGANIZED 1888



Second
Floor
Plan



First
Floor
Plan

First and second floor
plans of the residence illus-
trated on the opposite page.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING COMPANY



INCORPORATED 1908



Residence at Hastings-on-Hudson, New York.

Lester Kintzing, New York, Architect.

The first story walls of this house are constructed of 8 inch Natco Hollow Tile. The walls are neither furred nor waterproofed and are covered with white stucco. The floors are wood, the foundations stone and the roof shingle. Welsh quarry tile is used in the floors of porches. The house has hot water heating and electric light throughout.

NATCO HOLLOW TILE

VARIOUS TYPES OF Natco Hollow Tile Construction

TO exemplify more fully the broad possibilities of Natco Hollow Tile Construction, a series of illustrations of other types of buildings executed on the same general principles as the residences already shown follow.

In no better way could be demonstrated the remarkable flexibility of this form of construction, as fully meeting the requirements peculiar to any moderate sized building, no matter for what purpose it may be intended.

NATIONAL FIRE PROOFING COMPANY



REGISTERED TRADE MARK



Hotel at Hershey, Pennsylvania.

C. Emlen Urban, Lancaster, Pa., Architect.

The walls of this building are constructed of 12, 10 and 8 inch Natco Hollow Tile. The outside surface of the Tile walls is plastered with cement mortar and coated with waterproof paint. The main cornice is trimmed with red tile. All trimmings are painted white, except the iron balustrades of the balcony and front porch, which are painted dark green. The first story is used as a large department store and the second story as a hotel. The building measures 120 feet square.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING · COMPANY ·



INCORPORATED 1897



The Rumson Club, Red Bank, New Jersey.

Freeman & Hasselman, New York, Architects.

The walls of this building are constructed of 10 and 12 inch Natco Hollow Tile set on poured concrete foundations. The cellar partitions and first floor are of Hollow Tile. The other floors are wood. The outside finish is gray stucco and the roof is green slate. In addition to the club rooms, such as lounging rooms, three private dining rooms, one main dining room, grill room, billiard room, ladies' reception rooms, lockers, dressing rooms and toilets, there are thirty bed rooms for members, with fifteen private bathrooms attached. The main building measures 60 ft. by 200 ft. and the wing 35 ft. by 85 ft. There is steam heat throughout.

NATCO · HOLLOW · TILE

NATIONAL FIRE-PROOFING COMPANY



ORGANIZED 1888



Laboratory at Summit, New Jersey.

Starrett & Van Vleck, New York, Architects.

The walls of this building are constructed of 12 inch Natco Hollow Tile set on 16 inch concrete foundations, and are neither furred nor waterproofed. The outside finish is white stucco, trimmed with red brick. The floors are reinforced concrete and the roof red slate. The building construction is said to be very satisfactory, and owing to the hollow walls is cooler in summer and easily heated in the winter. The building measures 40 ft. by 80 ft. and the complete cost was about \$25,000.

NATCO-HOLLOW-TILE

NATIONAL FIRE PROOFING COMPANY



INCORPORATED 1888



School Building at Pawling, New York.

Stowe Phelps, New York, Architect.

This is another example of Natco Hollow Tile walls with brick facing, as illustrated on page 74.

The walls of this building are backed up with 12, 10 and 8 inch Natco Hollow Tile and are not furred. The walls are faced with brick veneer tied with galvanized iron anchors every five courses, 2 feet apart. The foundations are concrete and stone, the floors wood and the roof slate. The building measures 40 ft. by 314 ft., and has steam heat and electricity throughout.

NATCO HOLLOW TILE

NATIONAL FIRE-PROOFING · COMPANY ·



INCORPORATED 1894



School Building at Roselle Park, New Jersey. Pierce & Bickford, Elmira, New York, Architects.

This building is fireproof throughout, the foundations, walls, floors, partitions, stairs, columns and roof being of Hollow Tile construction combined with reinforced concrete. The outside walls are constructed of Natco Hollow Tile with cement stucco finish. The extreme dimensions of the building are about 80 ft. by 142 ft., covering about 11,000 square feet of ground and containing about 517,000 cubic feet. The total contract price for constructing this building complete was \$65,000, and this was estimated to be less than the cost if built with brick walls and wooden floors.

NATCO-HOLLOW-TILE

NATIONAL FIRE PROOFING · COMPANY ·



INCORPORATED 1904



Apartment House at Providence, Rhode Island. Frank W. Woods, Providence, R. I., Architect.

The outside walls of this building are constructed of 12 inch Natco Hollow Tile. The foundations are concrete and the outside stucco a grayish white. The roof is of red Spanish tile and the iron work is painted olive green. Cornice and brackets are stained mahogany. There are nine apartments, six containing five rooms and bath and three containing four rooms and bath. The apartments have servants' rooms and bath in attic, also storerooms.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1888



Store and Apartment Building at Westfield, New Jersey. Henry C. Piker, Westfield, Architect.

The first and second story walls are constructed of 12 inch Natco Hollow Tile set on 16 inch concrete foundations, while the third story walls are of 8 inch Tile. The walls are not furred and are finished with white stucco and waterproofed on the outside. The floors are wood and the roof of fancy tile. The building includes 6 stores and 12 apartments, each apartment containing 5 rooms, private hall and bathroom. There is steam heat, gas and electric light throughout.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1888



Store and Apartment Building at Maplewood, New Jersey. Ernest Greene & Lucius Clark Main, New York, Associate Architects.

The first story walls are constructed of 10 inch Natco Hollow Tile, while the second and third story walls are of 8 inch Tile. The walls are waterproofed on the inside of the Tile and finished with gray stucco on the outside. The foundations are concrete, the party wall brick, and the first floor reinforced concrete. The upper floors are wood. The building includes 2 stores and 2 apartments, each of the latter containing 8 rooms and bathroom. The cost complete was \$18,000.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING • COMPANY •



ORGANIZED 1898



Hospital at Bayside, Long Island.

Franklin and Ayres, New York, Architects.

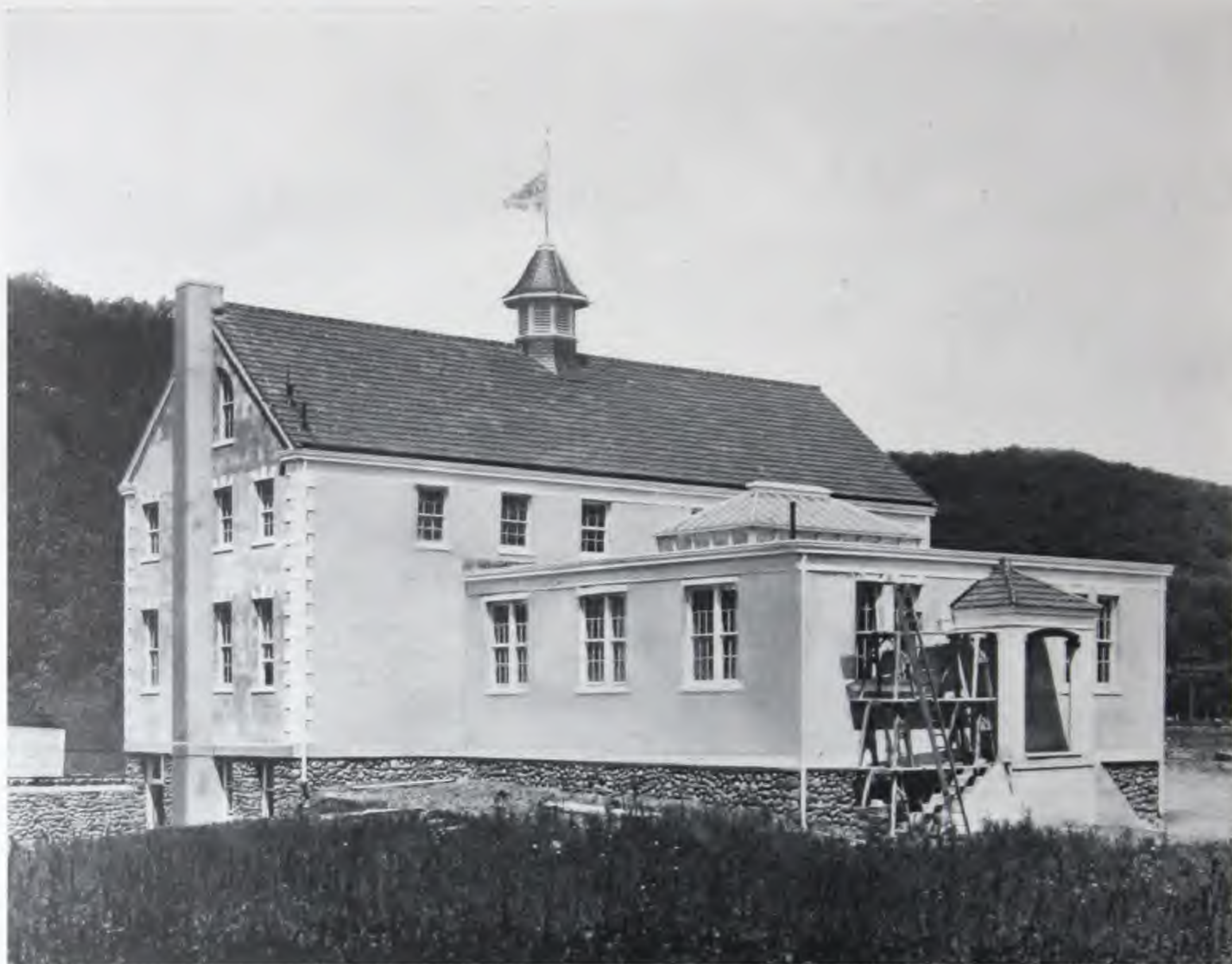
The walls of this building are constructed of 8 inch Natco Hollow Tile set on concrete foundations, and are neither furred nor waterproofed. The outside finish is gray stucco. The floors are wood and the roof shingle. The building has steam heat, gas and electric light throughout. The cost complete was about \$16,000.

NATCO HOLLOW TILE

NATIONAL FIRE-PROOFING · COMPANY ·



ORGANIZED 1888



Bottling Plant at Oakland, New Jersey.

Eli Benedict, New York, Architect.

The walls of this building are constructed of 12 inch Natco Hollow Tile, finished with gray stucco. The arch stones, window sills and corner quoins are of white Portland cement and marble dust. The foundations are concrete faced with round field stones. The floors are wood and the roof red tile. The building measures 36 ft. by 80 ft. and the extension 44 ft. by 44 ft.

The complete cost of the building was about \$15,000.

NATCO·HOLLOW·TILE

NATIONAL FIRE-PROOFING COMPANY



INCORPORATED 1908



Stable and garage of residence illustrated on page 15. Constructed of Natco Hollow Tile.

Wilson Eyre, Jr., Philadelphia, Architect.

Tennis house, with garage in the distance. Both constructed of Natco Hollow Tile.



Stable and garage of residence illustrated on page 25. Constructed of Natco Hollow Tile.

Robert W. Gardner, New York, Architect.

NATCO HOLLOW TILE

Details of Construction

for

NATCO HOLLOW TILE

Fireproof Houses

EXAMPLES on preceding pages show clearly the scope of Natco Hollow Tile Construction—the beautiful as well as practical results made possible thereby.

¶ The following pages show specific and graphic information as to the technical requirements of executing construction of this character.

¶ These details can be readily applied to any work where the use of Hollow Tile is contemplated.

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CCA



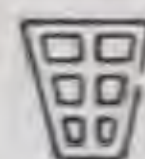
OWING to the great demand for Natco Hollow Tile for use in foundation work, we are now manufacturing a special 9 hole 12 x 12 x 12 block as shown above.

¶ This block affords a triple air space, regardless of how it is laid up, and also gives added strength to the wall, on account of additional web area.

**NATIONAL FIRE PROOFING
· COMPANY ·**



ORGANIZED 1889





NATCO XXX

(PATENTED)

The Improved Natco Hollow Tile

¶ Natco XXX as compared with regular Natco merely represents added strength in one of the strongest and most stable of all building materials. It realizes the very LAST degree of complete structural efficiency, its design being such that when set up

**EVERY SQUARE INCH OF WEBS AND SHELL
IS UNDER COMPRESSION.**

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CCA

NATIONAL FIRE PROOFING · COMPANY ·



INCORPORATED 1913



Above is a photographic reproduction of a typical *Natco Hollow Tile* member. The *visible* points of superiority, as compared with similar Tile of different makes, are the deep dovetail scoring for the better bonding of stucco or plaster, the absence of imperfections and the better general symmetry due to the more accurate machining by this Company's unequalled equipment.

Equally important qualities not obtainable in other tile are not so apparent to the eye. These consist of finer properties in the raw clay and its more uniform and thorough burning, resulting in greater density and a higher degree of inherent strength.

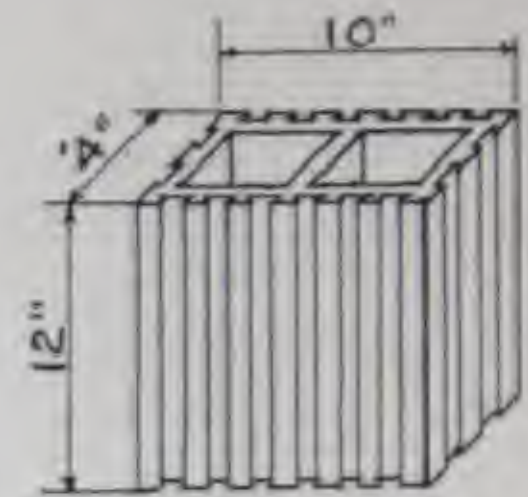
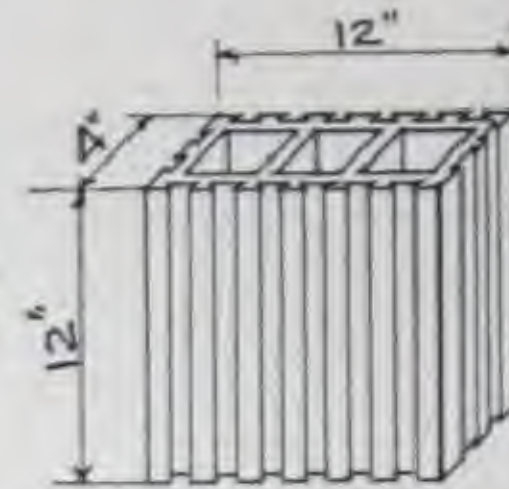
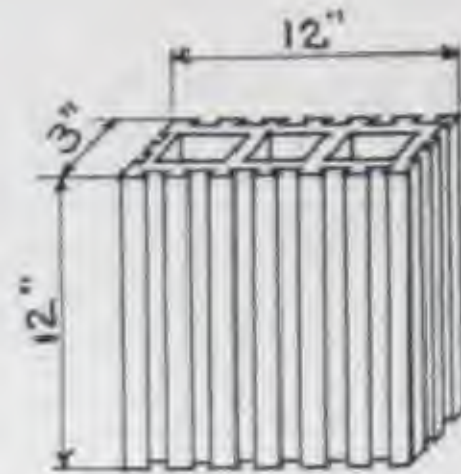
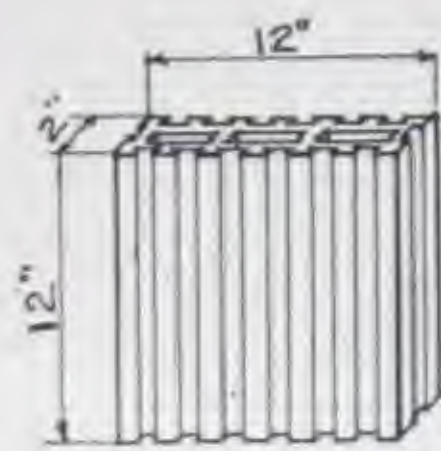
It is to certify these advantages, and to instantly identify the tile possessing them, that the name *Natco* is stamped plainly upon the face of each tile.

NATCO·HOLLOW·TILE

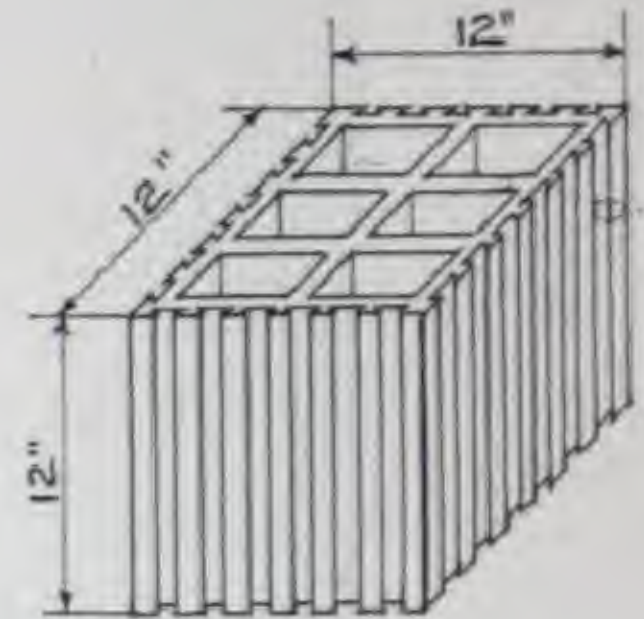
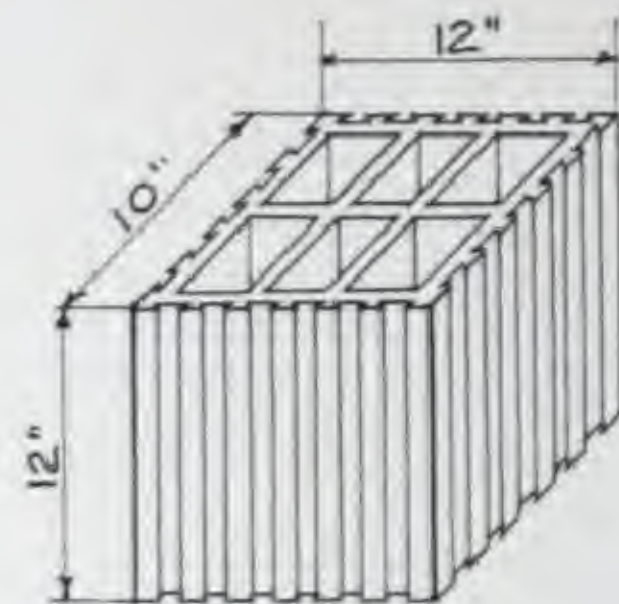
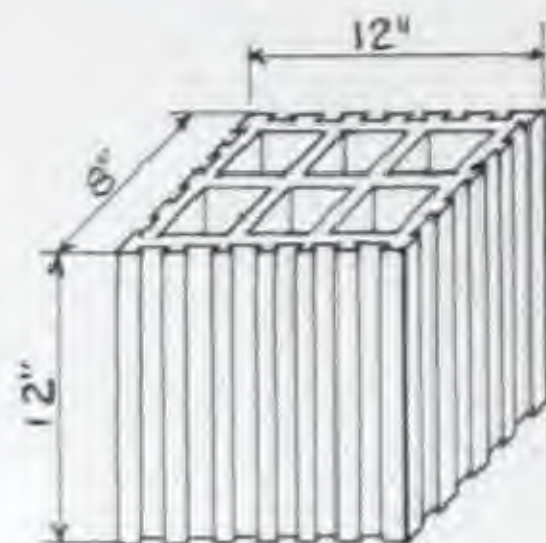
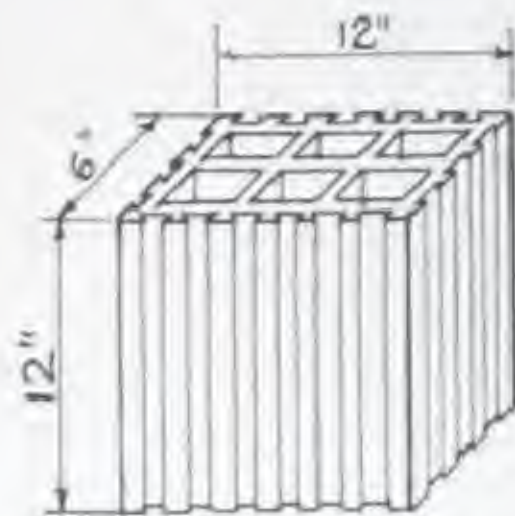
NATIONAL FIRE PROOFING · COMPANY ·



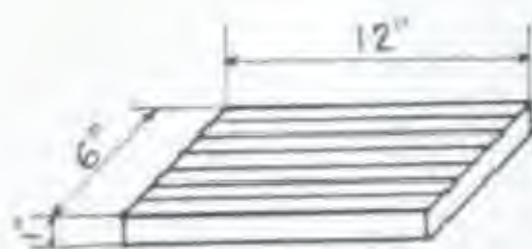
ORGANIZED 1889



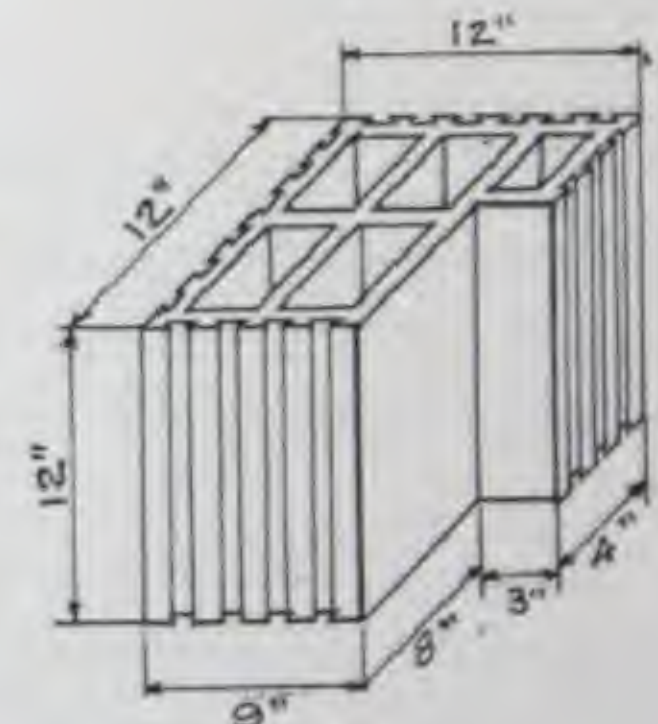
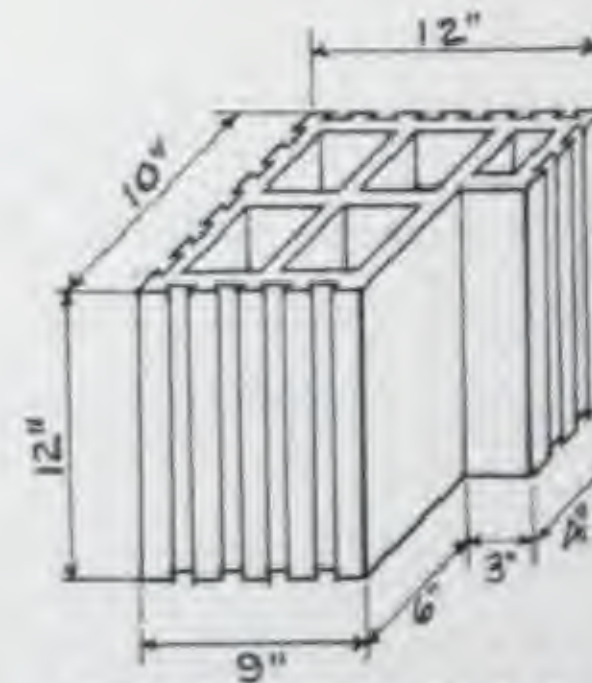
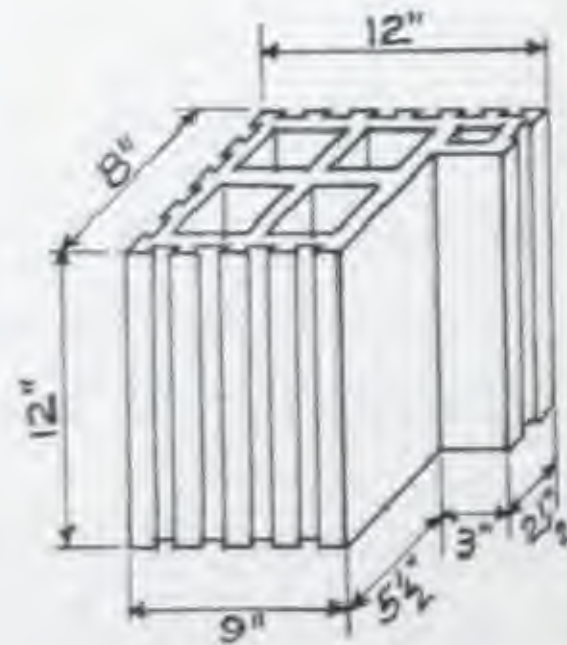
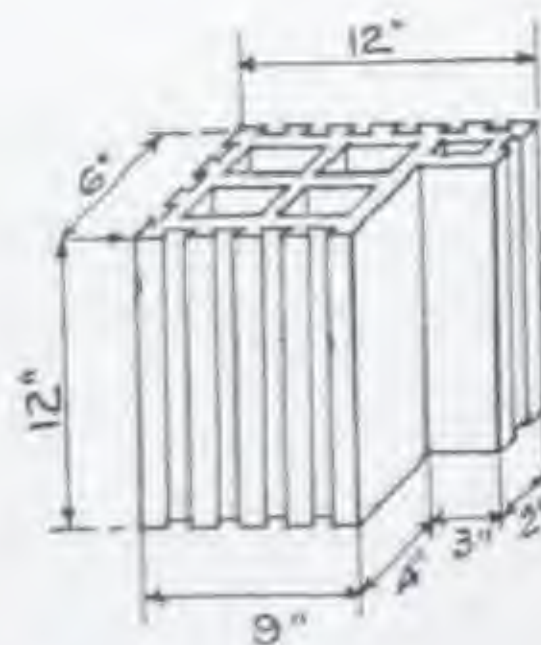
SPECIAL COR-
NER BLOCK



STANDARD WALL BLOCKS.



SOLID SLABS



JAMB BLOCKS

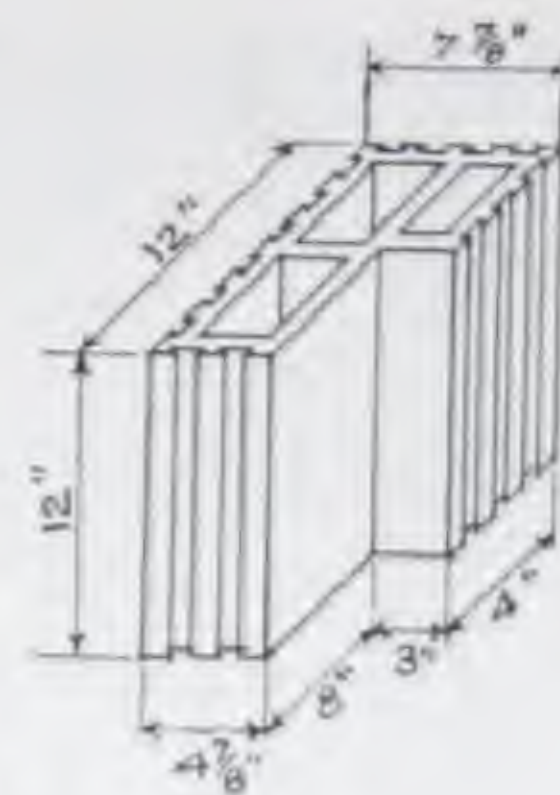
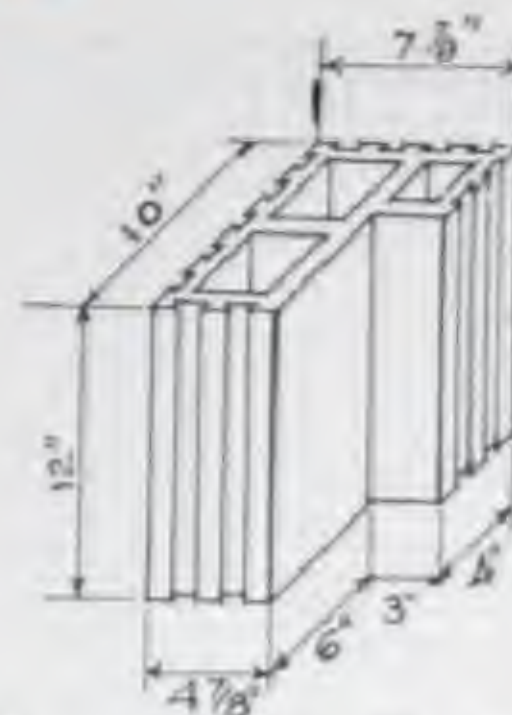
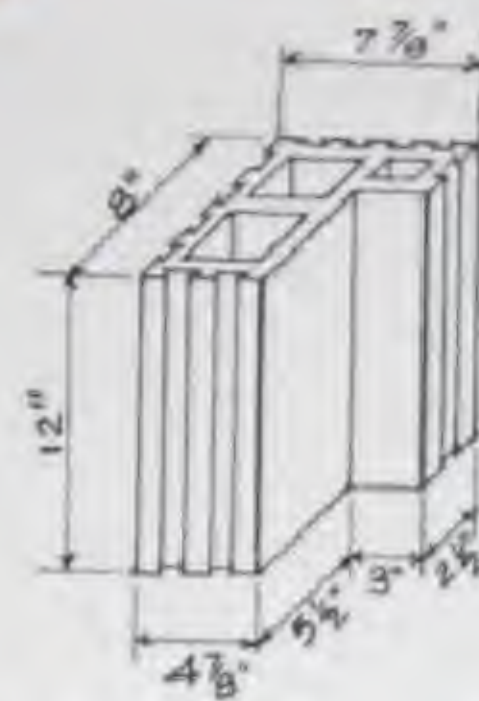
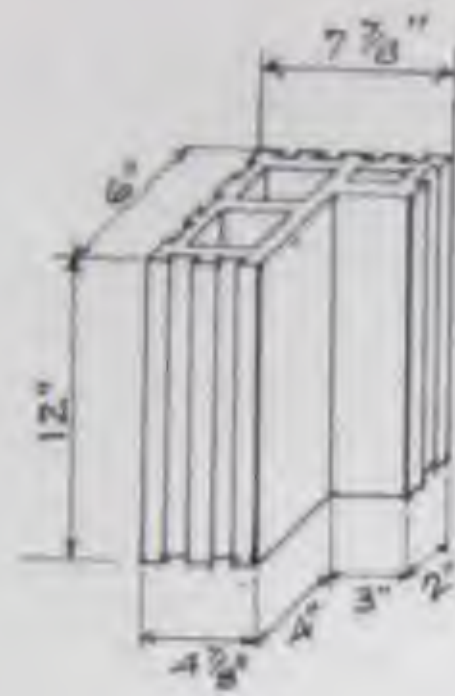
Jamb Blocks and Wall Blocks 4 inches thick and over are supplied in 6 inch and 3 inch heights. All estimates are made on a lump sum basis and the proper number of special shapes is furnished with each order.

NATCO·HOLLOW·TILE

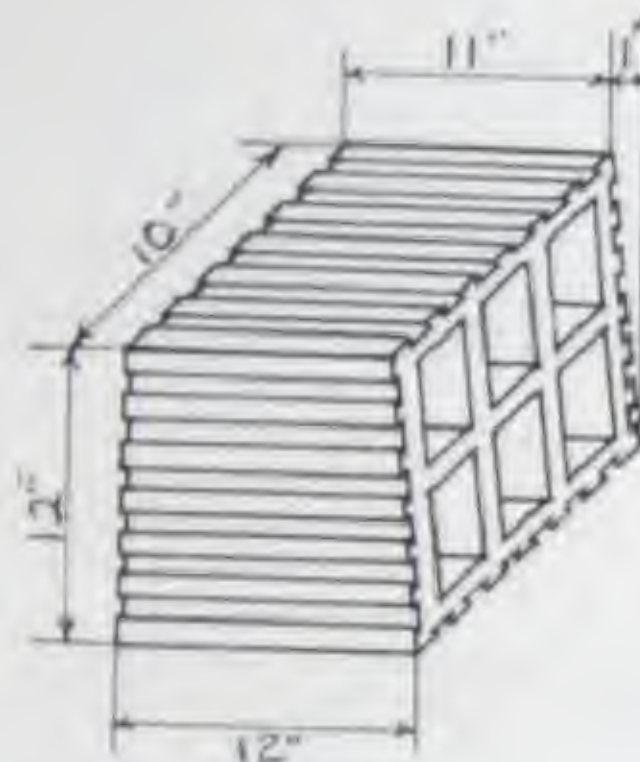
NATIONAL FIRE PROOFING · COMPANY ·



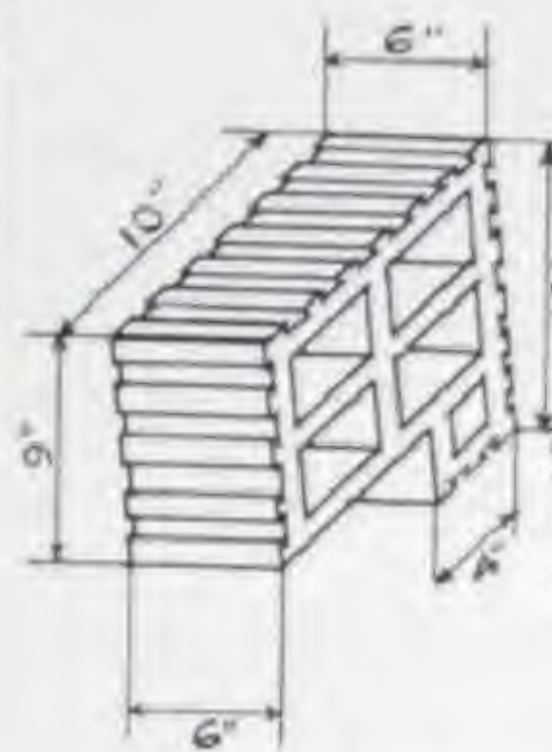
ORGANIZED 1884



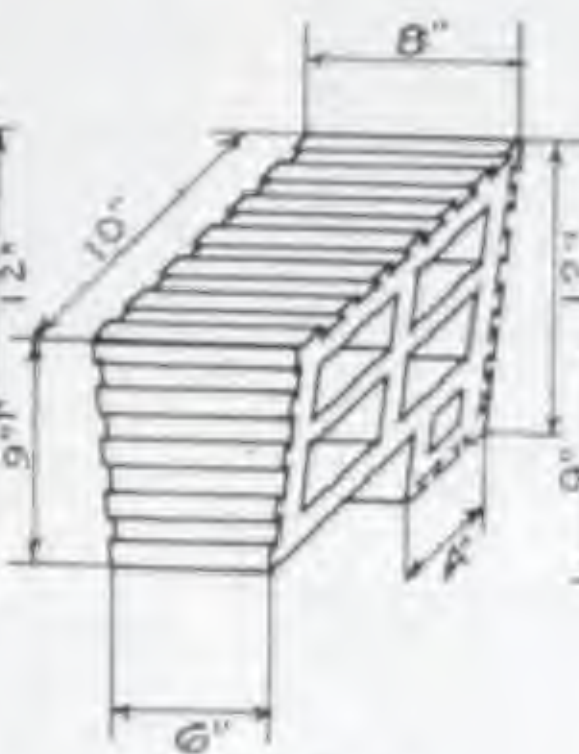
HALF JAMB BLOCKS



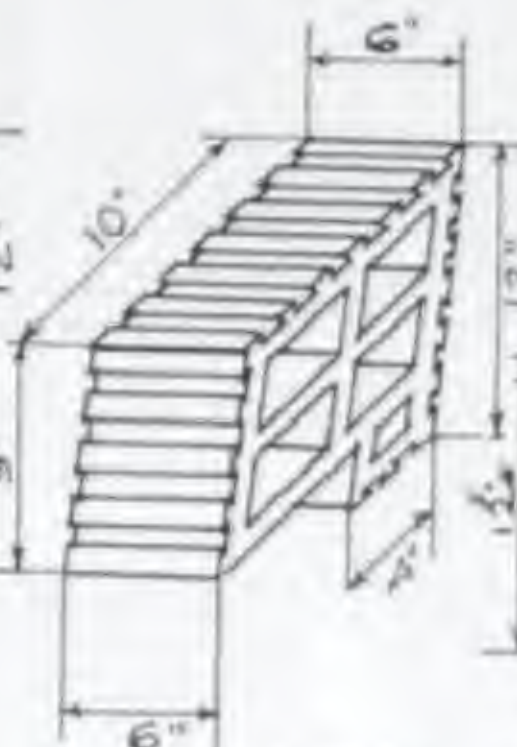
SKEW



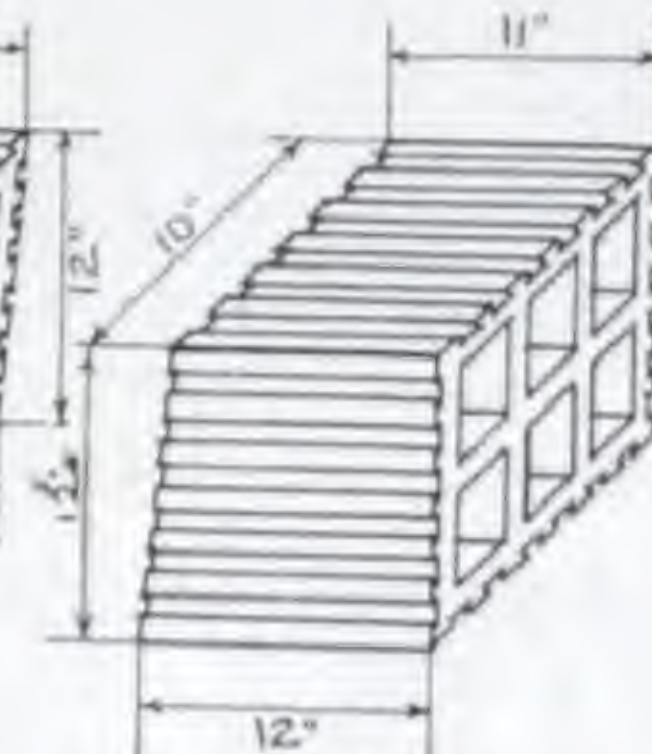
FILLER



KEY

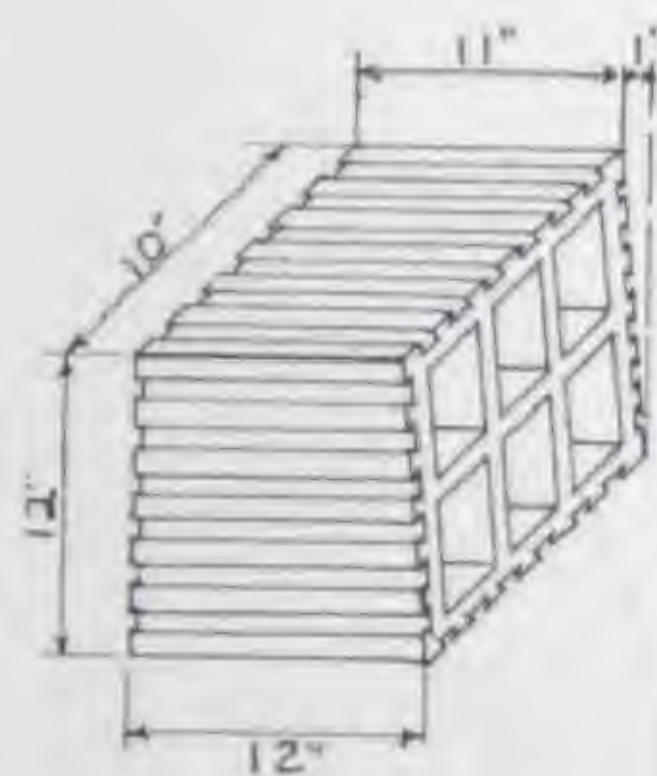


FILLER

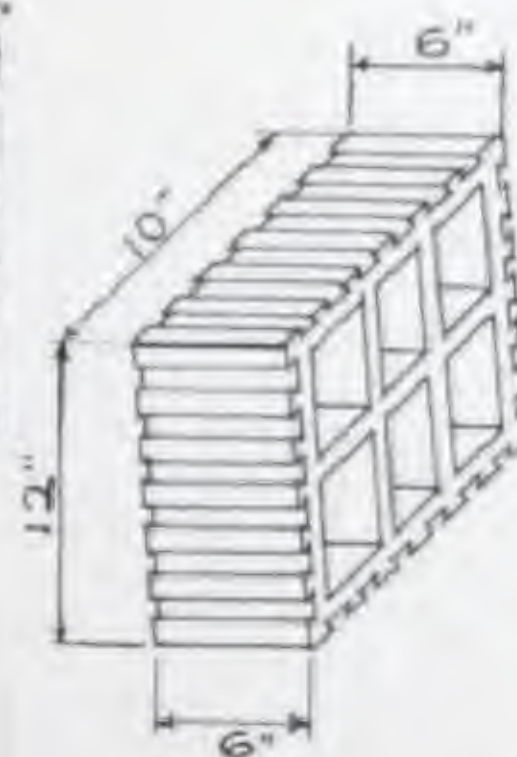


SKEW

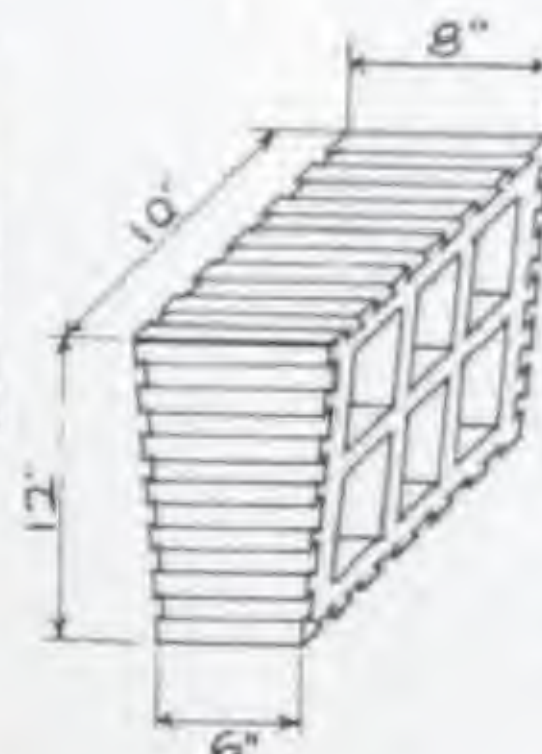
ARCH BLOCKS



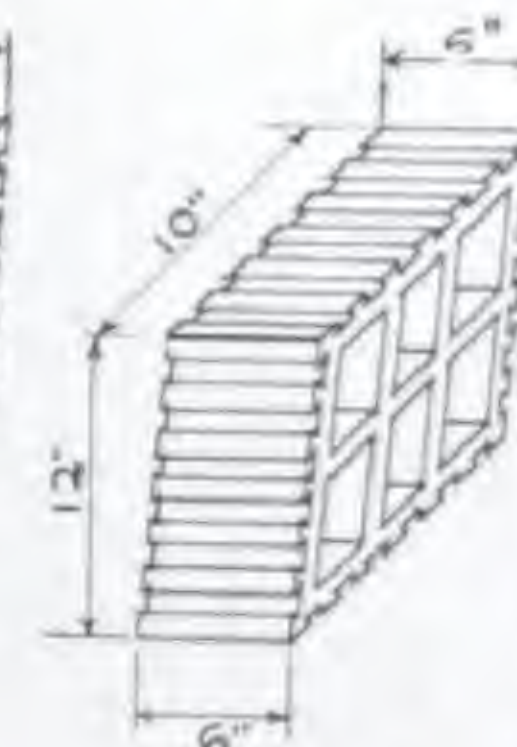
SKEW



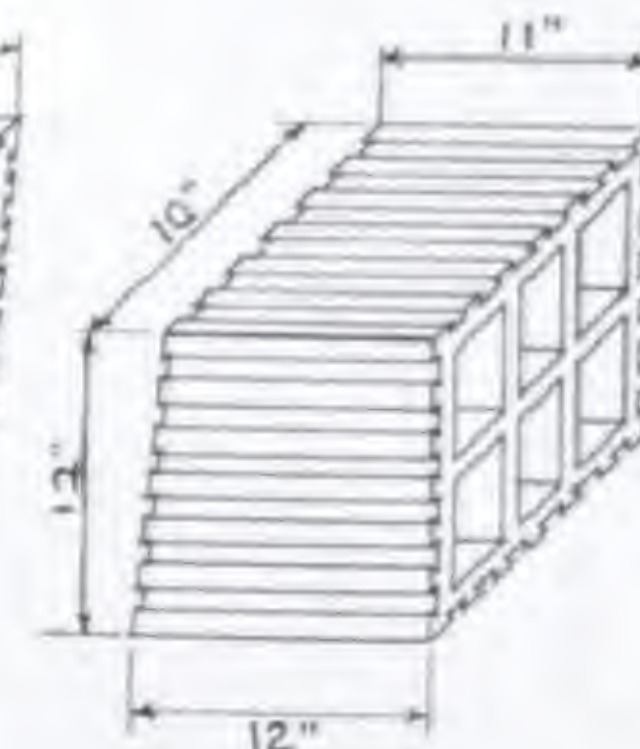
FILLER



KEY



FILLER



SKEW

ARCH BLOCKS

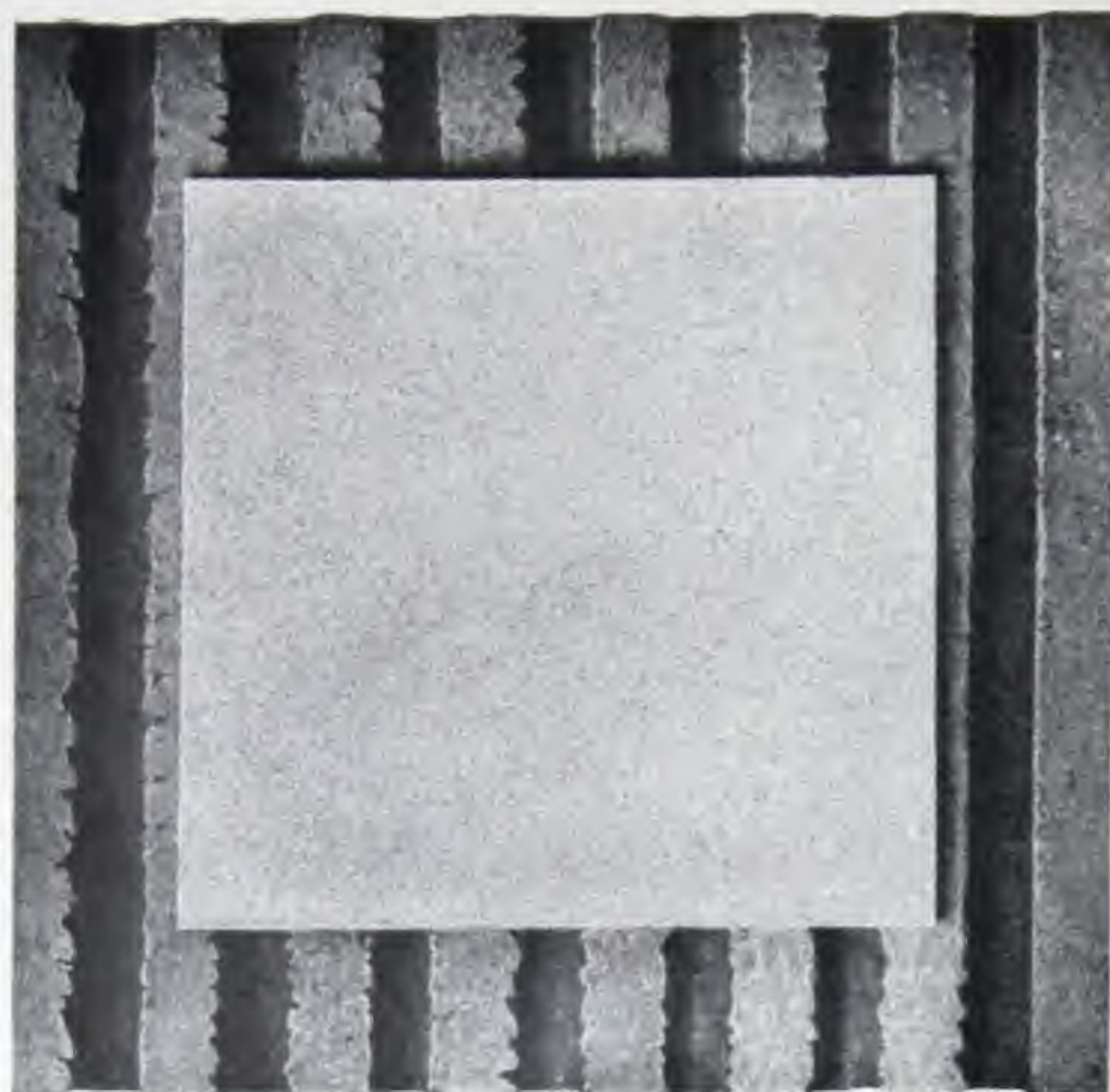
Arches are made both of rabbetted and rectangular shapes and of 6 in., 8 in., 10 in. and 12 in. thickness. All bevels are 1 in. in 12 in. of height. Length of arch is varied by increasing number of inters. Key block to be placed as near center of arch as possible. The above shows rectangular arch blocks 12 in. thick.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING · COMPANY ·



UNIONVILLE, PA.



SAND FINISH.

Composition of Portland Cement and Sand.



SAND FINISH STIPPLED.

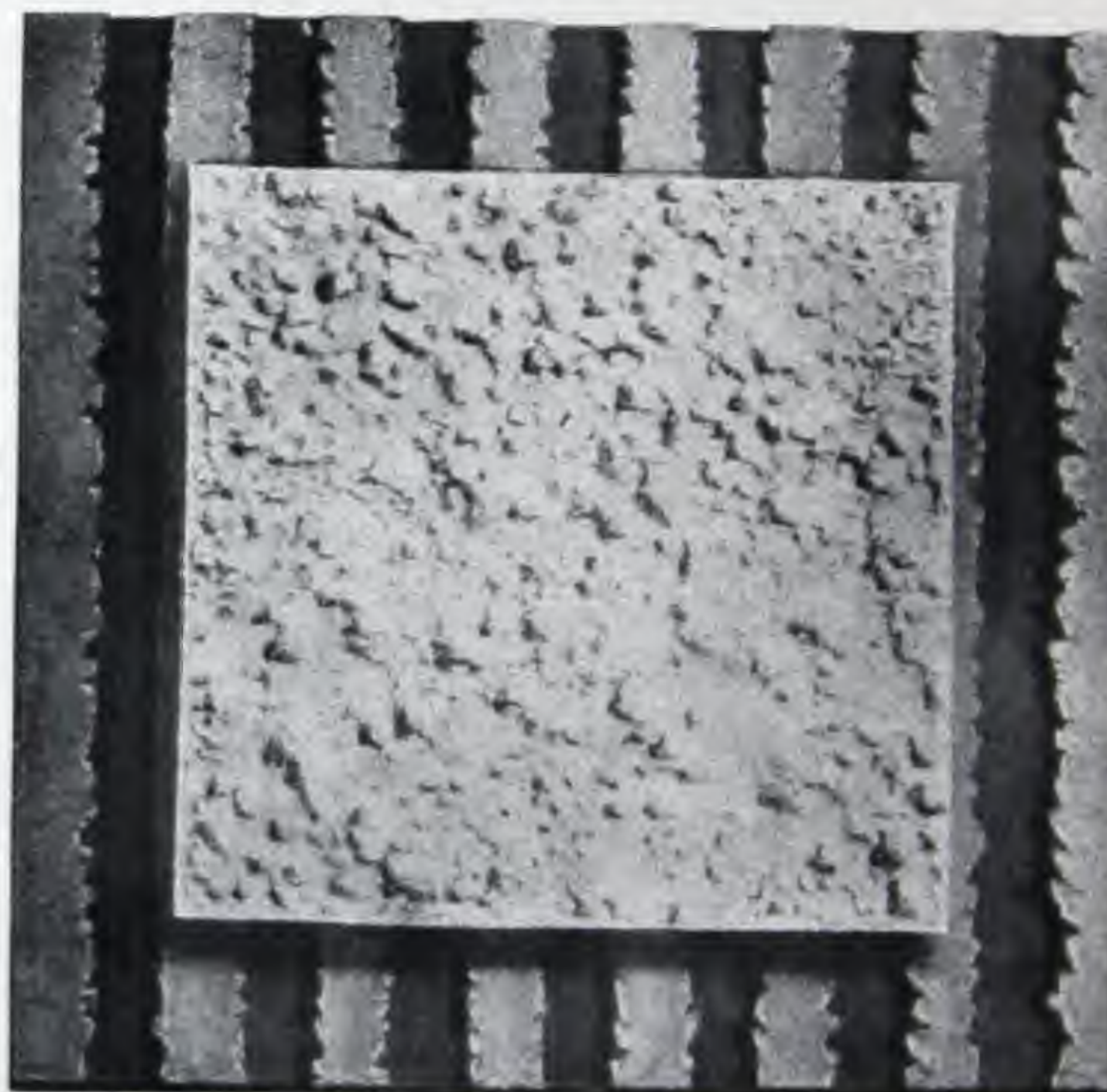
Composition of Portland Cement and Sand.



ROUGH CAST.

With Stone Screenings. Composition of Portland Cement, Sand and Stone Screenings.

These are only a few of the various finishes that may be obtained in Stucco, as applied to Natco Hollow Tile wall construction.



PEBBLE DASH.

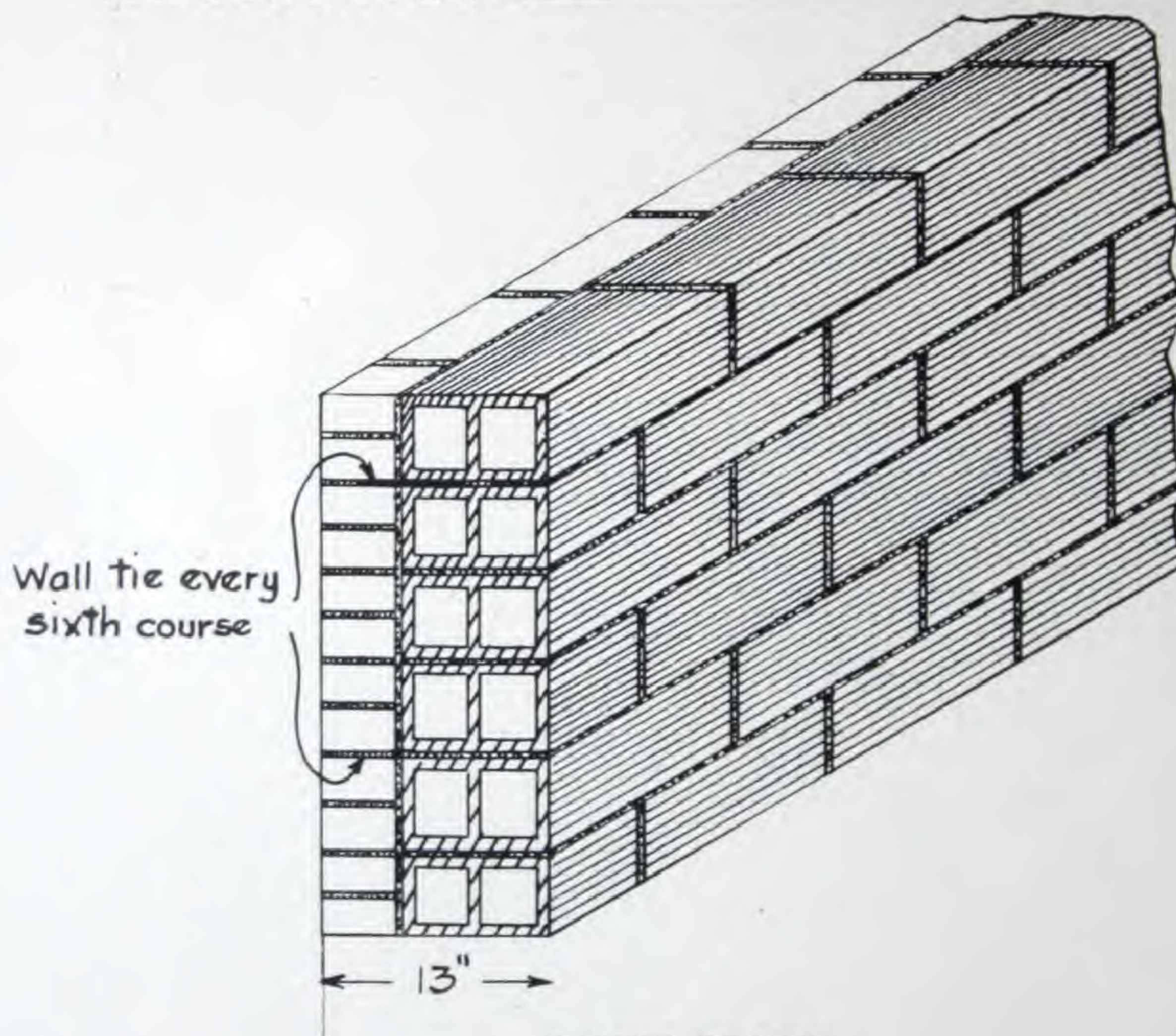
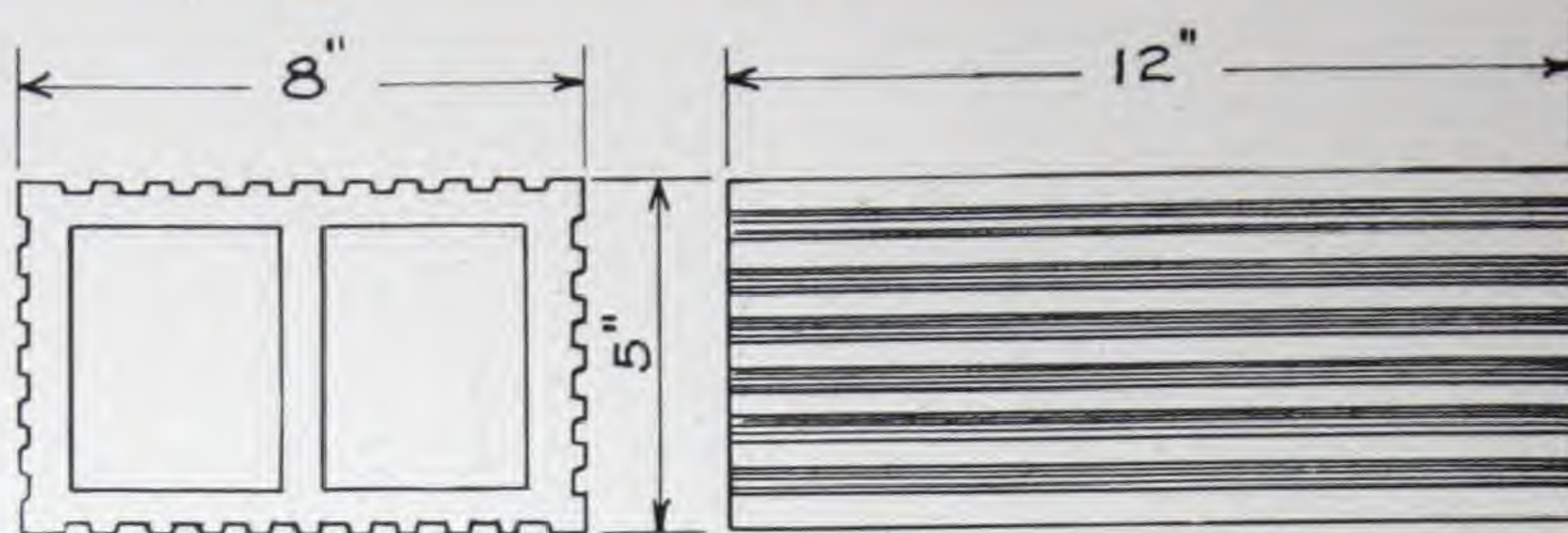
Composition of Portland Cement and Sand with Pebbles Applied.

NATCO·HOLLOW·TILE

NATIONAL FIRE-PROOFING · COMPANY ·



REGISTERED TRADE MARK



BAKUP BLOCK

Where a brick finish is desired, Hollow Tile is frequently used to back up the outside brick, thus affording the building the same fireproof and insulating value for the wall as in other Hollow Tile Houses.

For this purpose we make a specially designed block, known as the Backup Block, an illustration of the use of which is shown above. This block comes in two sizes, 5x4x12 and 5x8x12.

NATCO·HOLLOW·TILE

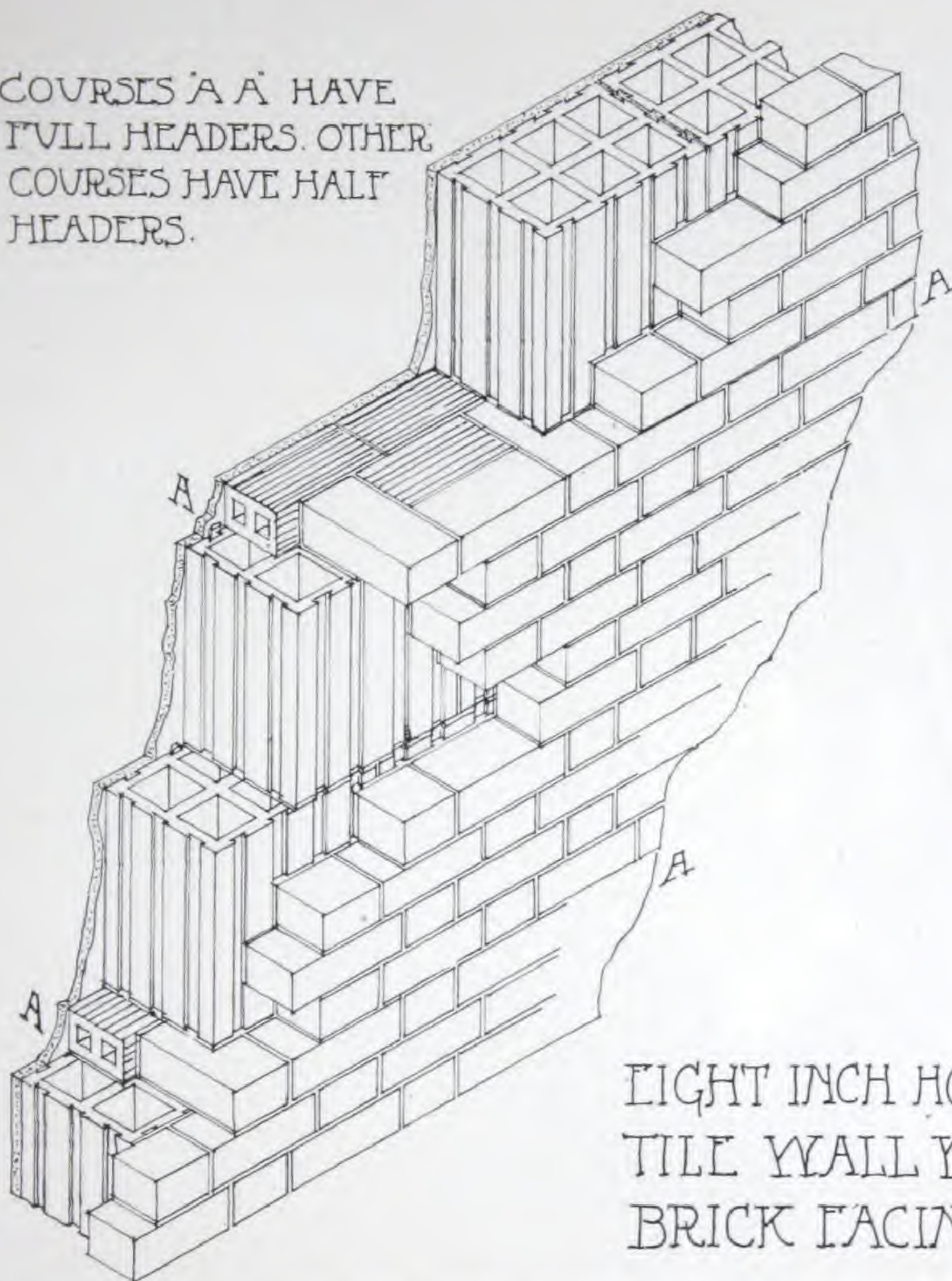
NATIONAL FIRE PROOFING · COMPANY ·



ORGANIZED 1888



COURSES A A HAVE
FULL HEADERS. OTHER
COURSES HAVE HALF
HEADERS.



EIGHT INCH HOLLOW
TILE WALL WITH
BRICK FACING.

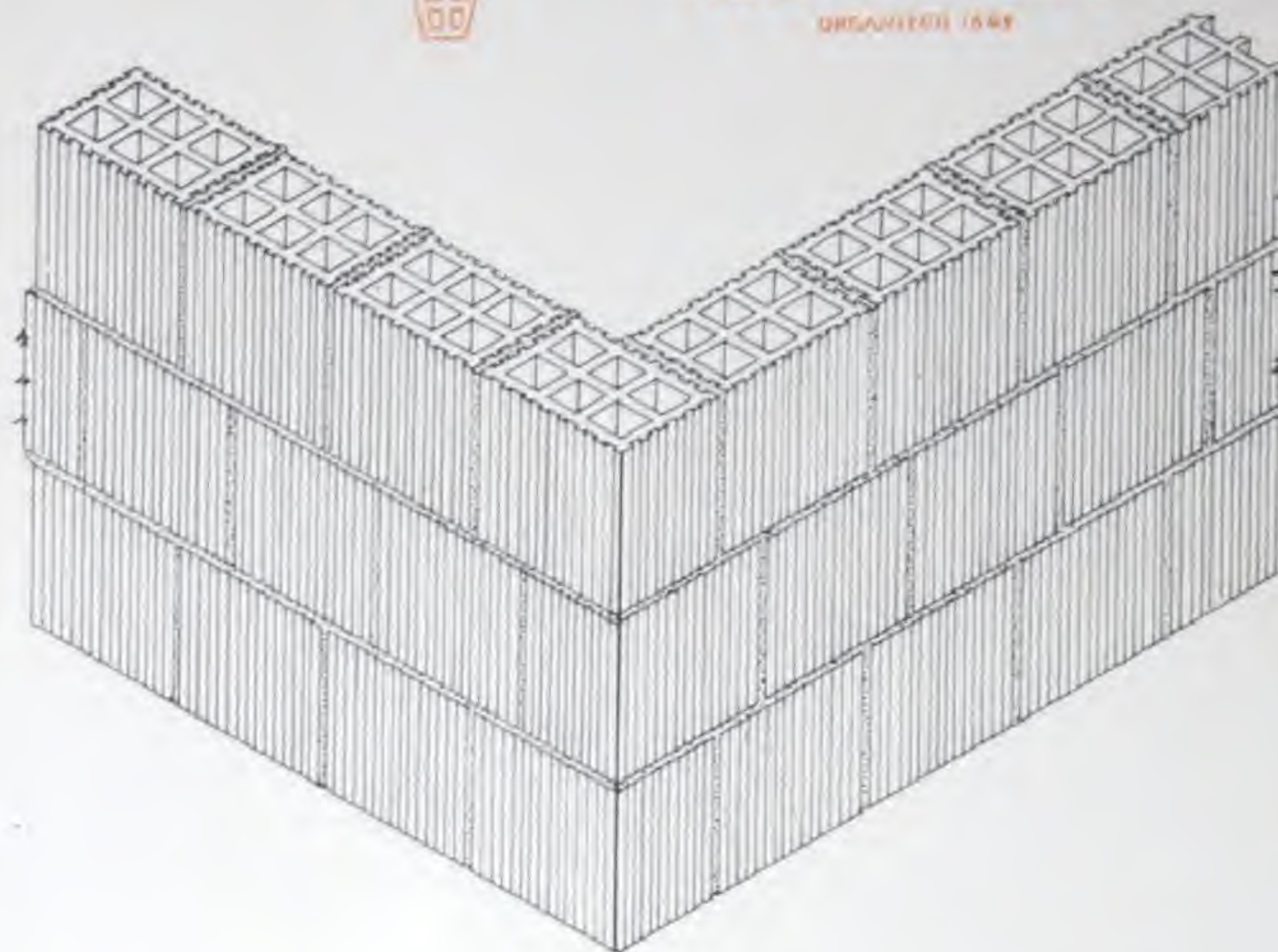
The above cut illustrates the method of backing up brick veneer with 8 x 12 x 12 Natco Hollow Tile. Every tenth course of brick is tied into the wall with a full header which is backed up with a row of hollow brick as shown in the drawing. All other courses have bats or half headers butting up against the block. This method of construction ties the tile and the brick in an absolutely rigid manner. A more common method of securing the brick veneer is by metal wall ties.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING · COMPANY ·



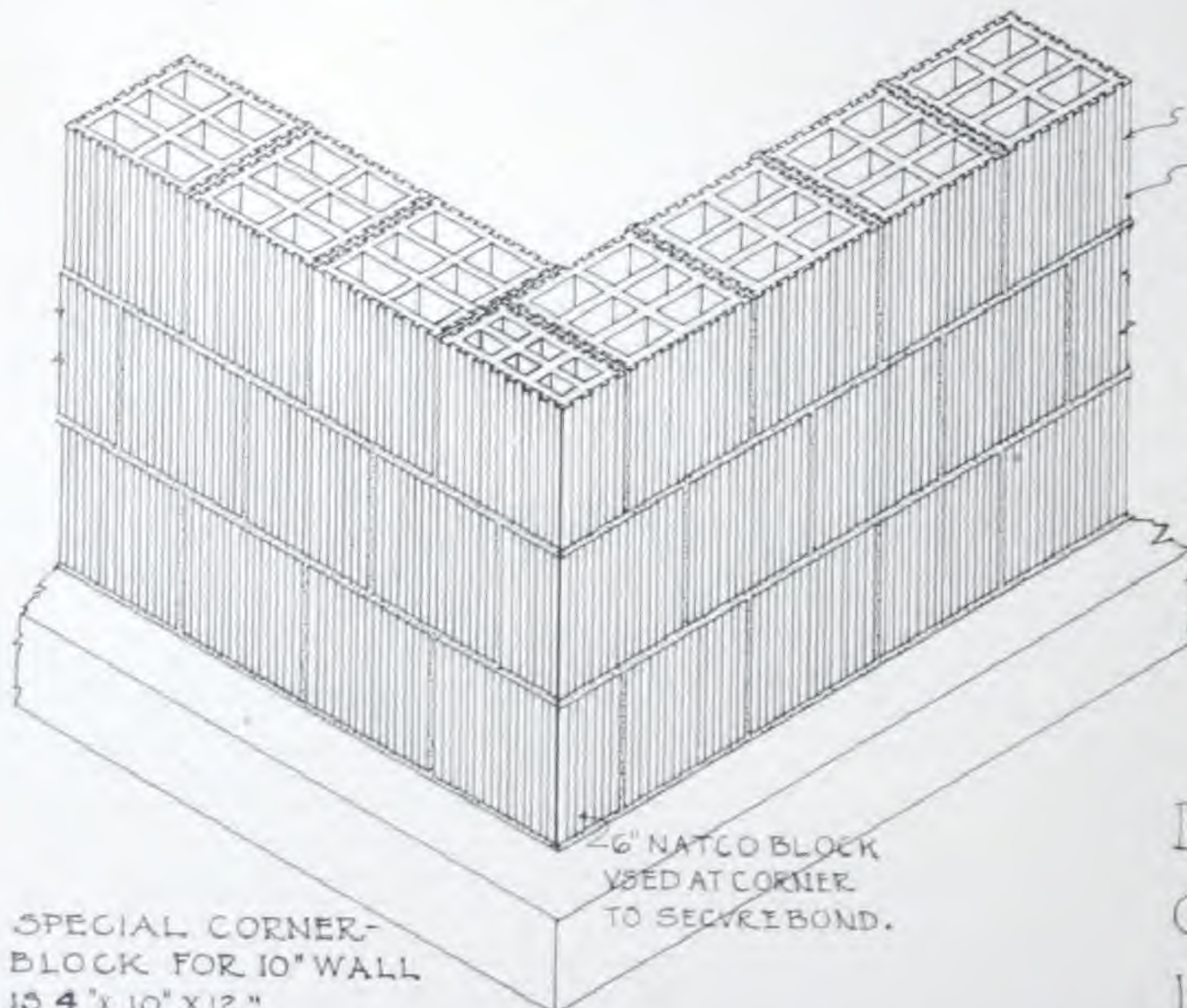
ORGANIZED 1889



8" NATCO BLOCK
PROJECTING DOVE TAIL
SCORED FOR STUCCO
AND PLASTER.

DETAIL OF COR-
NER OF 8" WALL.

SCALE
ONE FOOT



12" NATCO BLOCK,
PROJECTING DOVE TAIL
SCORED FOR STUCCO
AND PLASTER.

12" BLOCKS USED FOR
FOUNDATIONS, AND FOR
EXTERIOR WALLS WHERE
HEAVY LOADS ARE TO BE
CARRIED.

CONCRETE FOOTING.

DETAIL OF
CORNER OF
12" WALL.

SPECIAL CORNER-
BLOCK FOR 10" WALL
IS 4" X 10" X 12".

6" NATCO BLOCK
USED AT CORNER
TO SECURE BOND.

The above details show standard Natco Hollow Tile construction for foundation and super-structure.

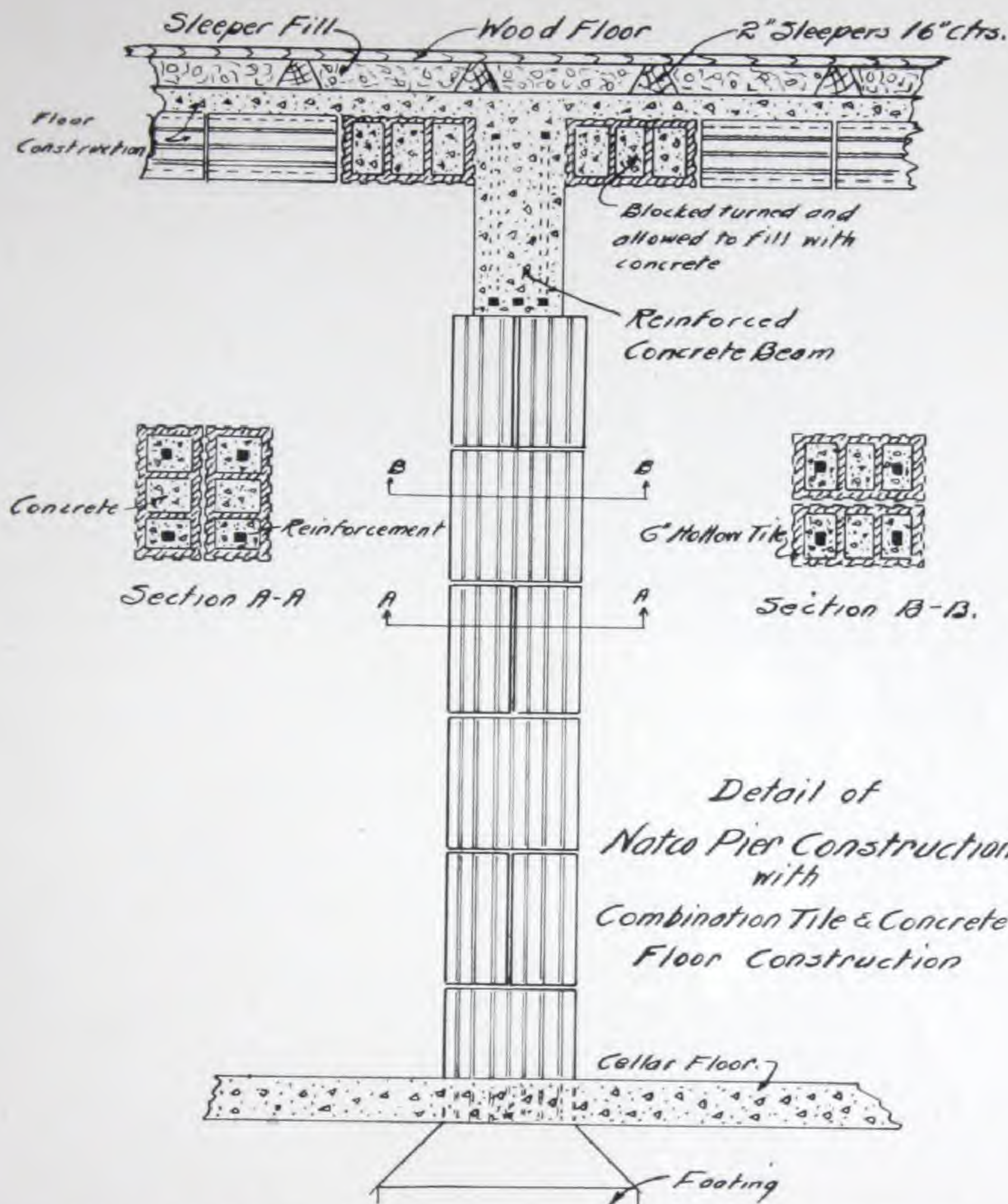
The 12 inch block is specially designed for foundations, giving the advantage of three air chambers through the thickness of the wall.

NATCO · HOLLOW · TILE

NATIONAL FIRE PROOFING COMPANY



INCORPORATED 1904



Where partitions are not called for, as in cellars, it is necessary to carry the floors on girders, which are in turn carried on columns.

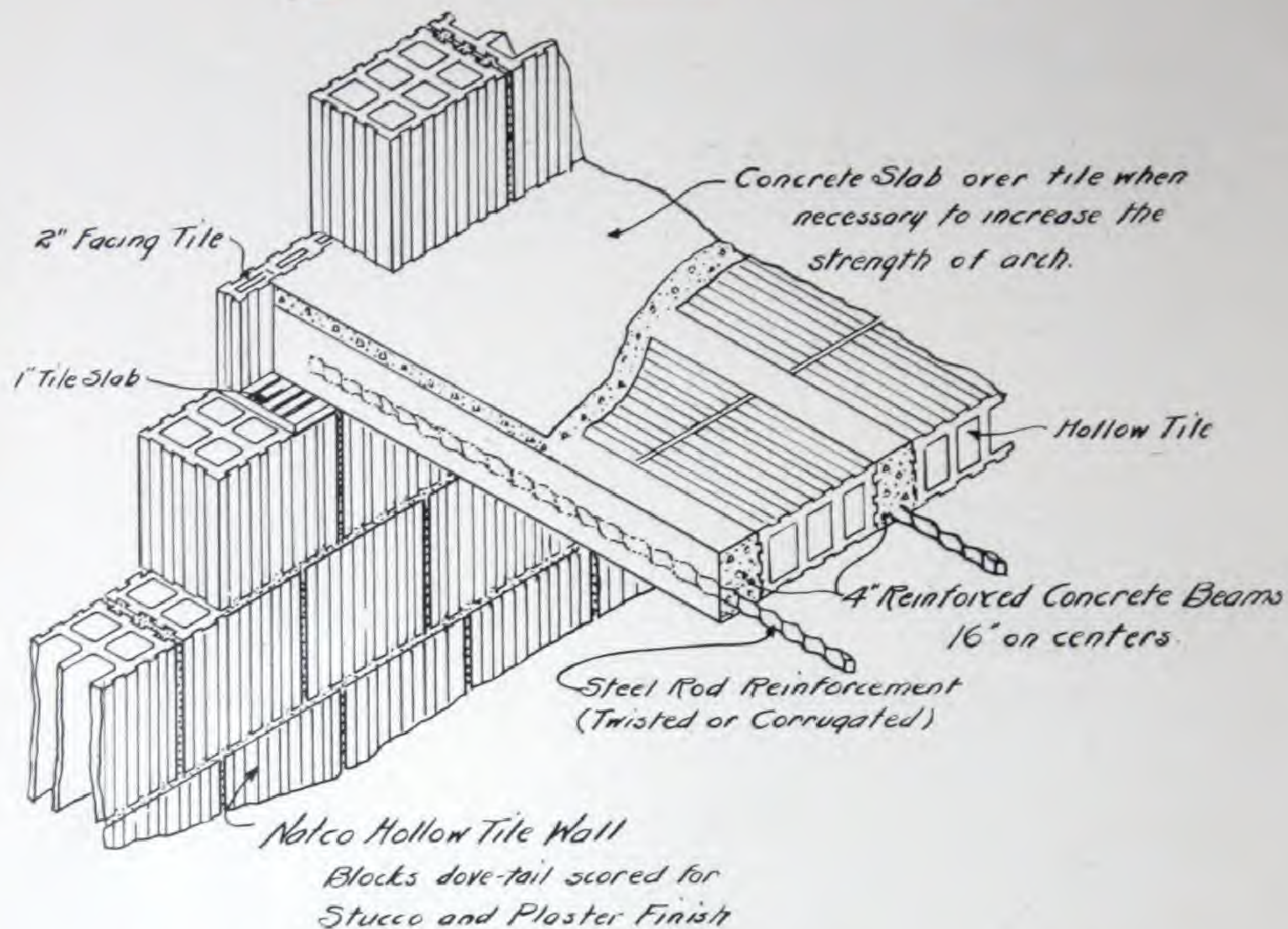
The column construction in such cases is detailed above. After the Natco Hollow Tile is laid up in these columns, the reinforcing steel is placed and the concrete poured into the hollow spaces of the tile, as shown in the small detail drawing. This gives an extremely strong column, capable of carrying a far greater load than would be called for in the construction of residence buildings, and does away with the necessity for wooden centering for constructing columns.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1888



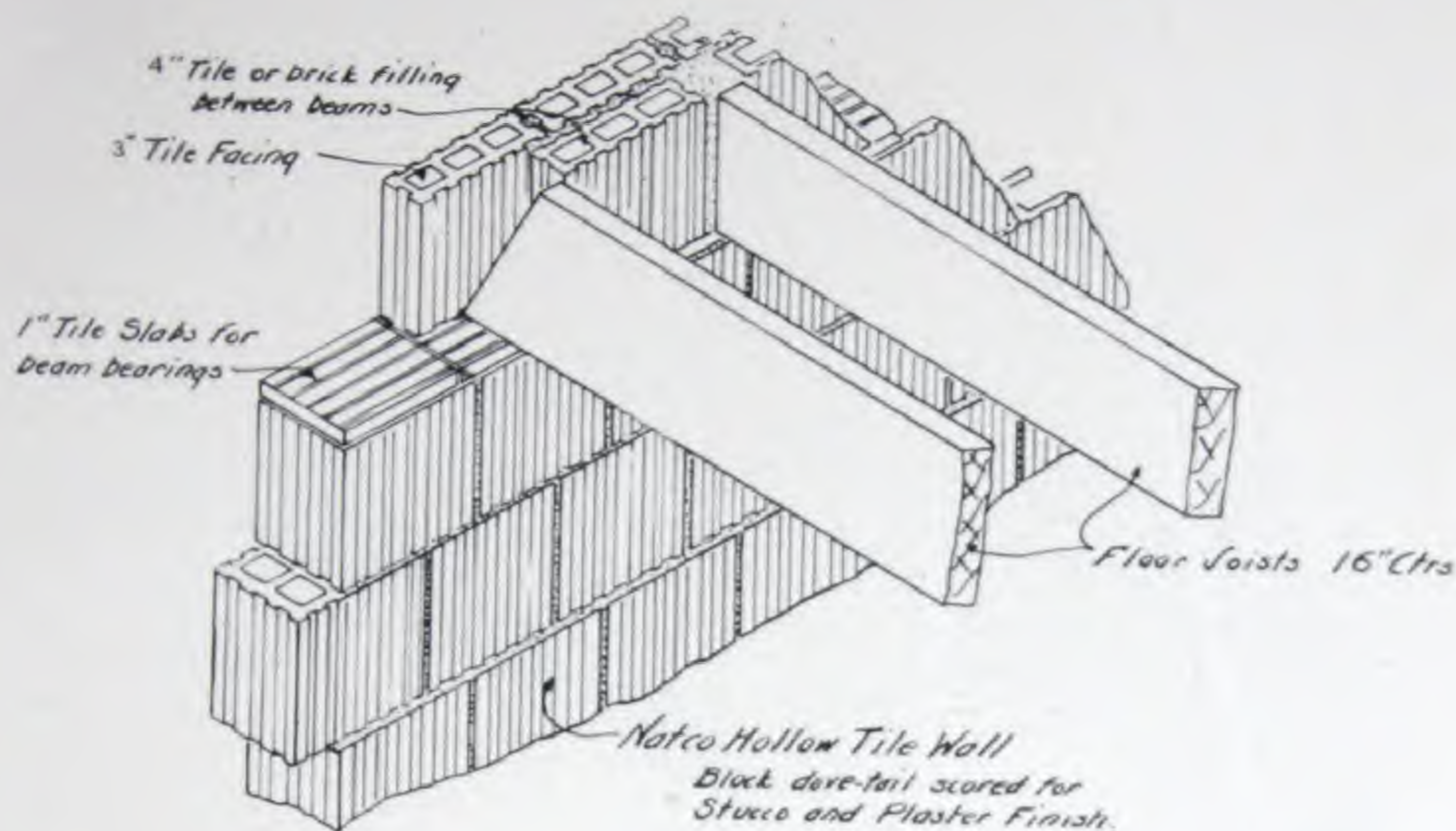
Detail of wall Construction of Natco Hollow Tile with fireproof floor of Hollow Tile and reinforced concrete beams. This floor can be carried safely over very long spans, as shown in our Load Table on Page 86.

The ceilings may be left flat, ready to receive the plaster from the concrete. Beams may be dropped down 2 or 3 inches, as required, to give the beam ceiling effect so often desired in residences.

The Natco Hollow Tile can be furnished in half blocks in order to overcome story heights, so that any desired level for the floor may be obtained.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



Detail of Wall and Floor construction for a house of fireproof Natco Hollow Tile walls with wood floors.

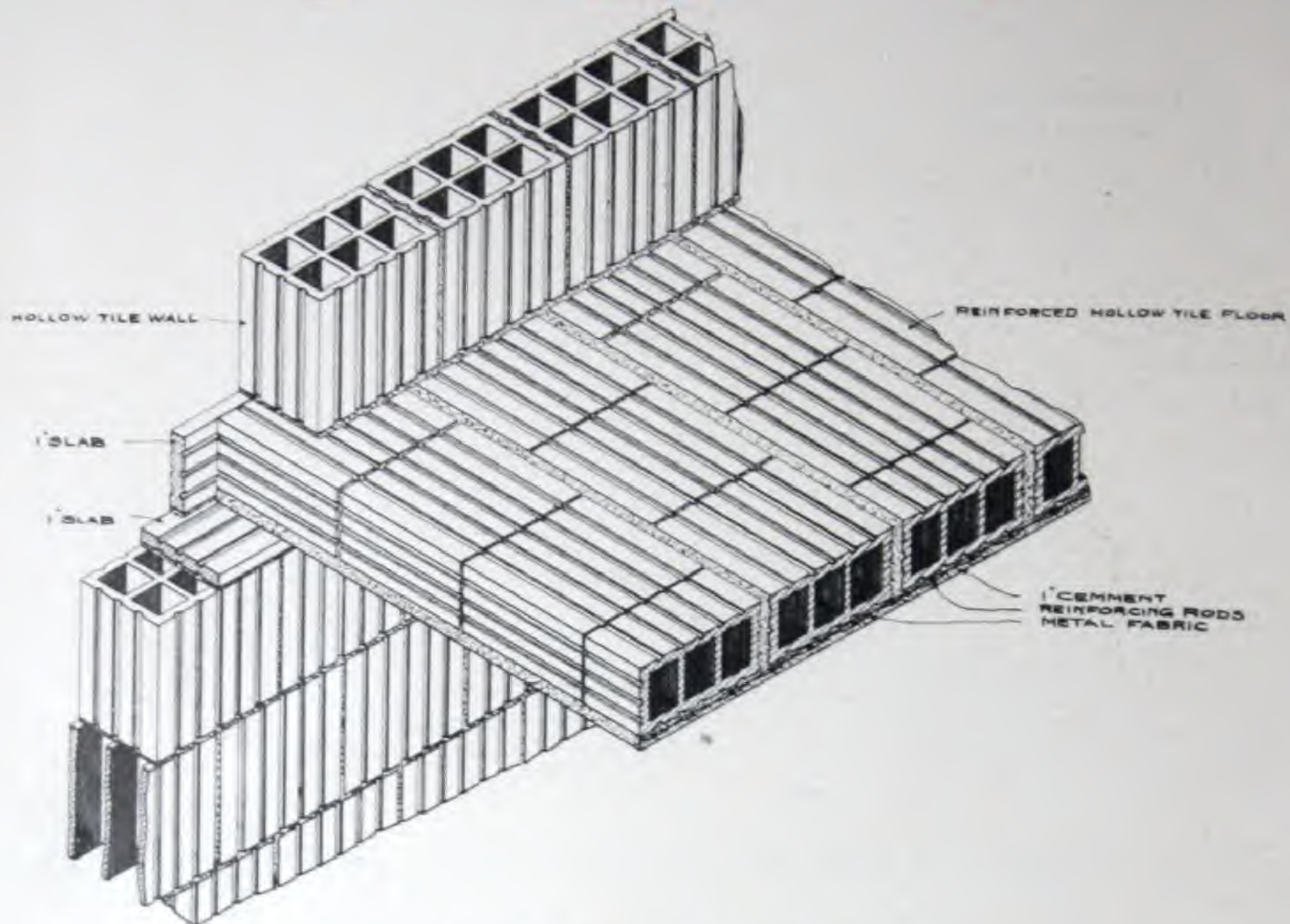
A building of the construction detailed above cannot be characterized as fireproof, except as to its walls. The walls, of course, give the superior insulating value of Tile construction, insuring a warm, dry interior in winter and a cool house in summer. They also permit plastering to be applied direct to tile wall without furring or lathing, making a further economy.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1887



Detail of Johnson System Floor.

The Johnson Floor has been used in spans up to 25 feet, with entirely satisfactory results in every way. It is constructed chiefly of Terra Cotta Hollow Tile Blocks, the standard fireproofing material, which cannot be molecularly damaged by fire.

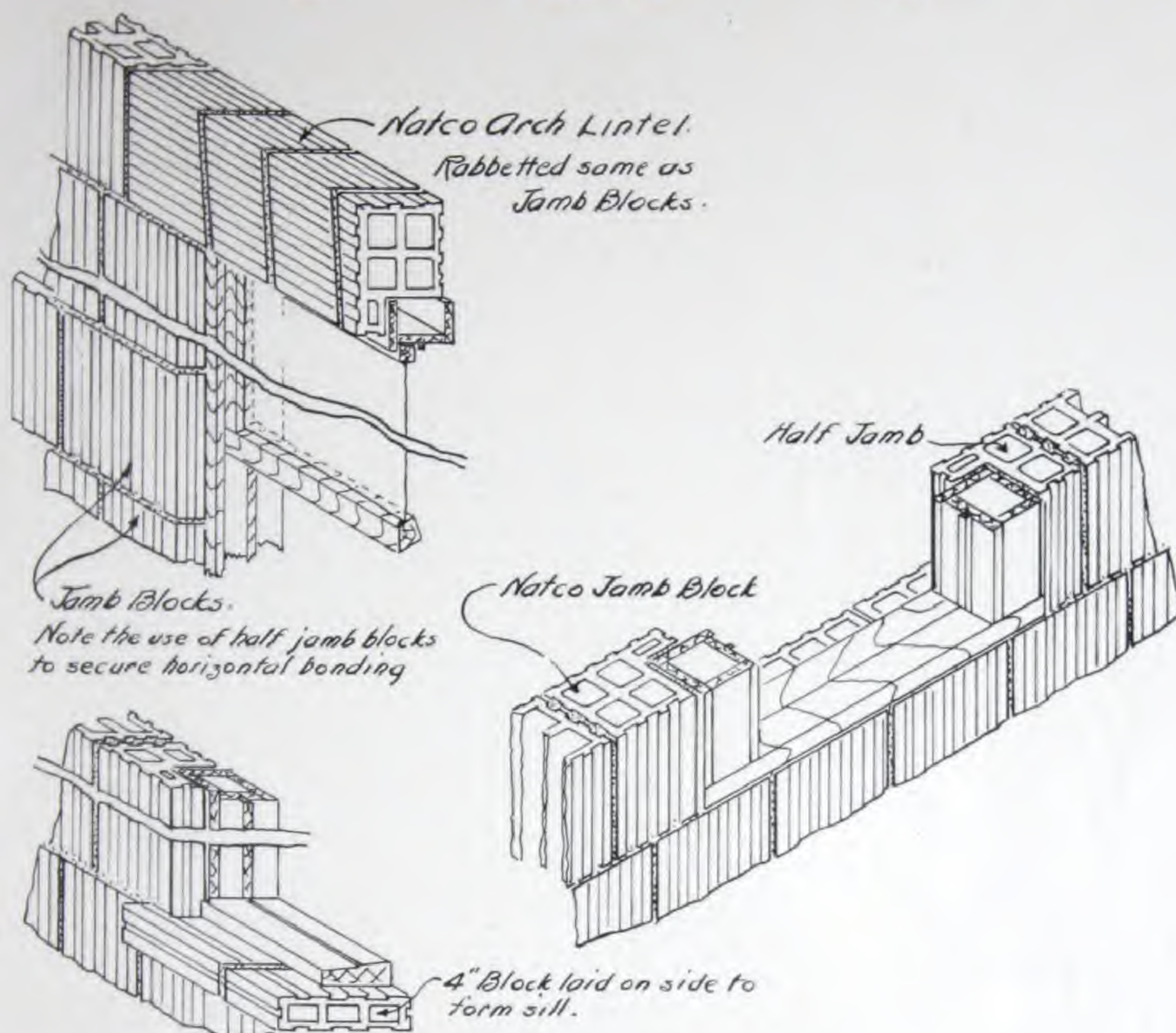
This floor construction is the lightest fireproof floor on the market, and is especially adapted for house construction on account of its use in the construction of long span floors as shown in our Load Table on page 88.

NATCO·HOLLOW·TILE

NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1888

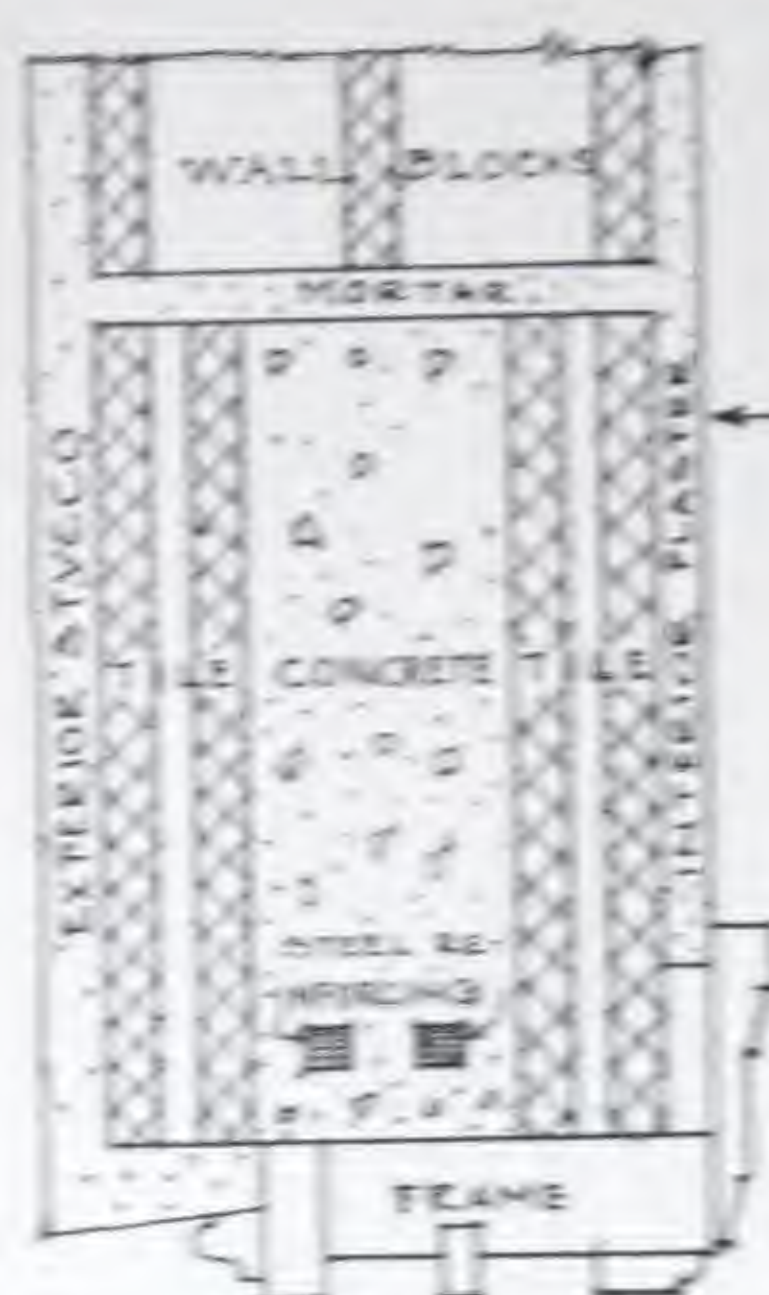


Details of Window Sill and Lintel Construction in connection with specially designed Natco Jamb Block, as shown on Page 70.

The various problems in window construction have been carefully studied and solved economically, as shown in these details. Note the damp preventing lip on the Jamb Block. Also, note the Lintel Block, which is exceptionally strong, cheap to install and presents a tile surface on both sides of the wall. The above form of tile sill is the one most generally used.

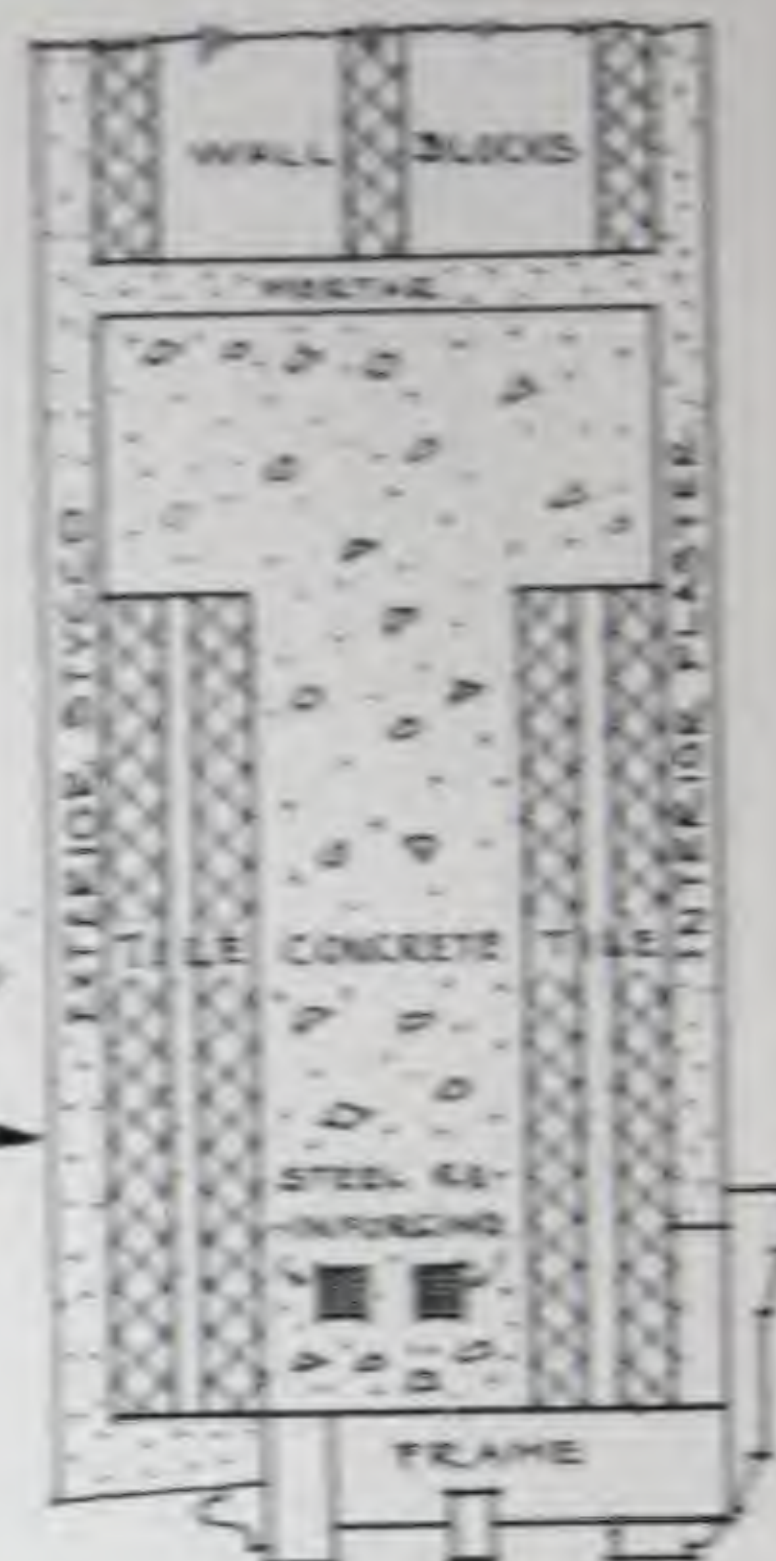
NATCO HOLLOW TILE

NATIONAL FIRE-PROOFING · COMPANY ·

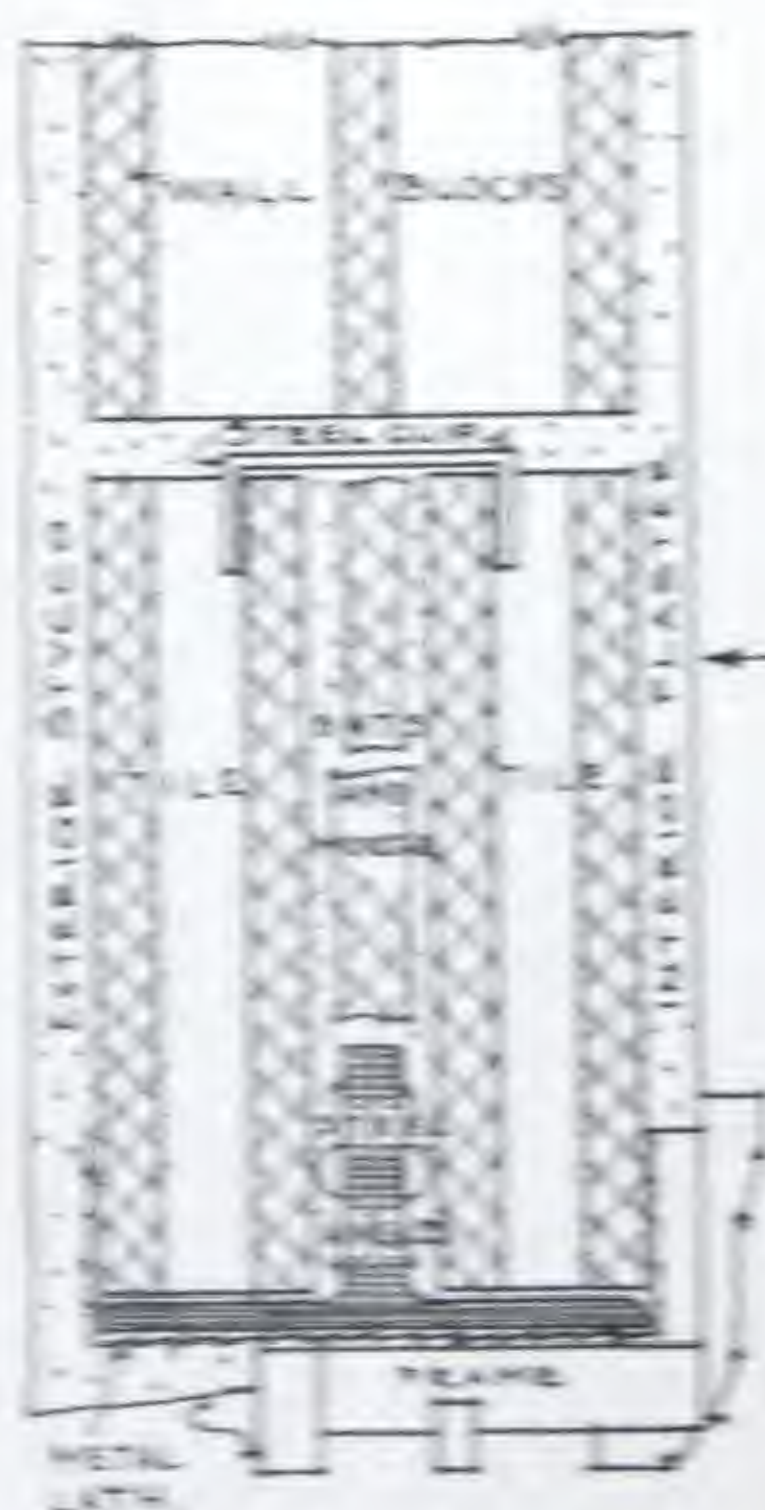


REINFORCED CON-
CRETE BEAM FACED
INSIDE AND OUT WITH
2" NATCO BLOCK

SAME WITH "T" FOR
ADDITIONAL STRENGTH

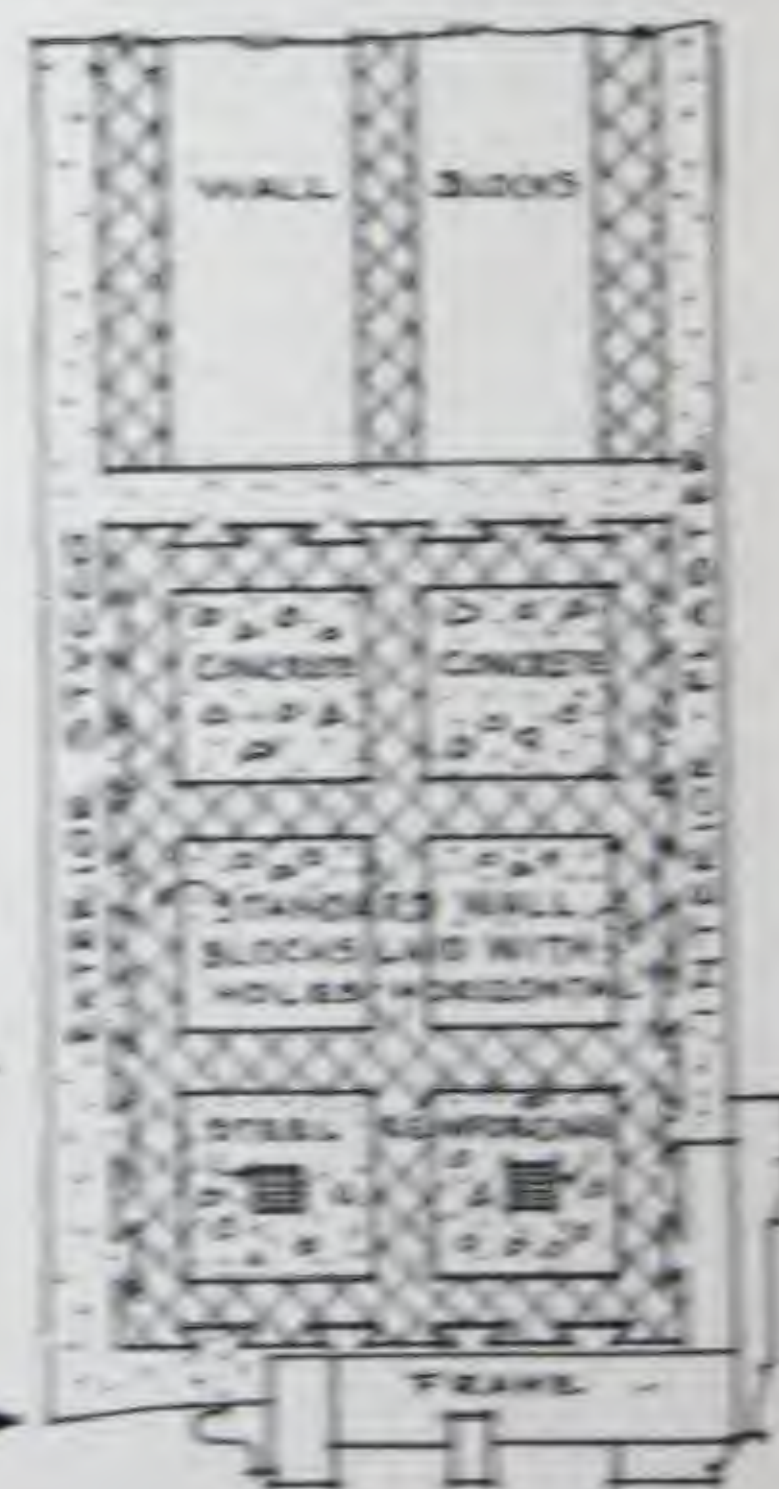


LINTELS



FACING TILE
CARRIED ON
LINTEL FORMED
OF ANGLES RIVETED
BACK TO BACK

REINFORCED LINTEL
FORMED OF STANDARD
WALL BLOCKS HAVING
ALL HOLES FILLED
WITH CONCRETE
FOR ADDITIONAL
STRENGTH



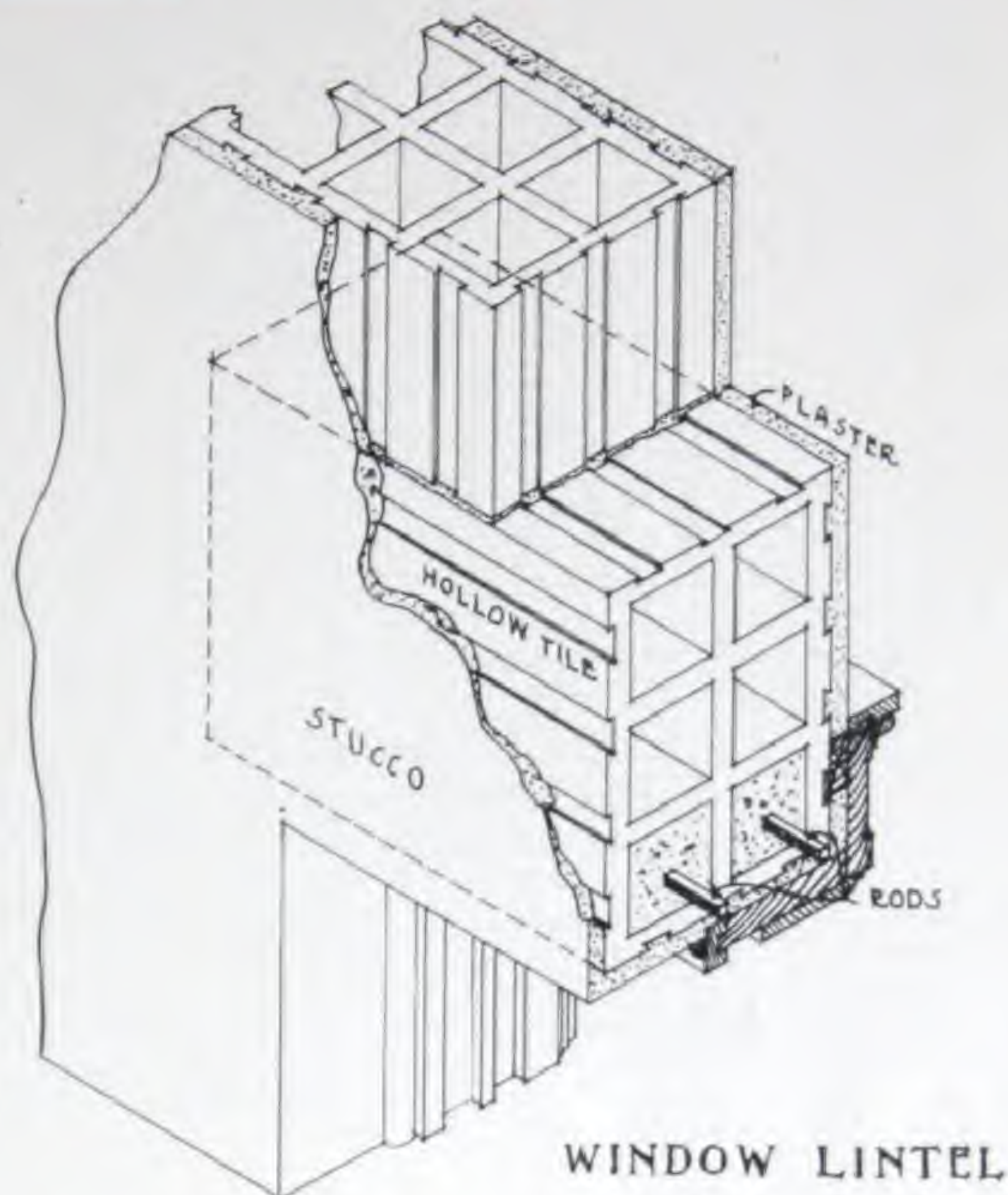
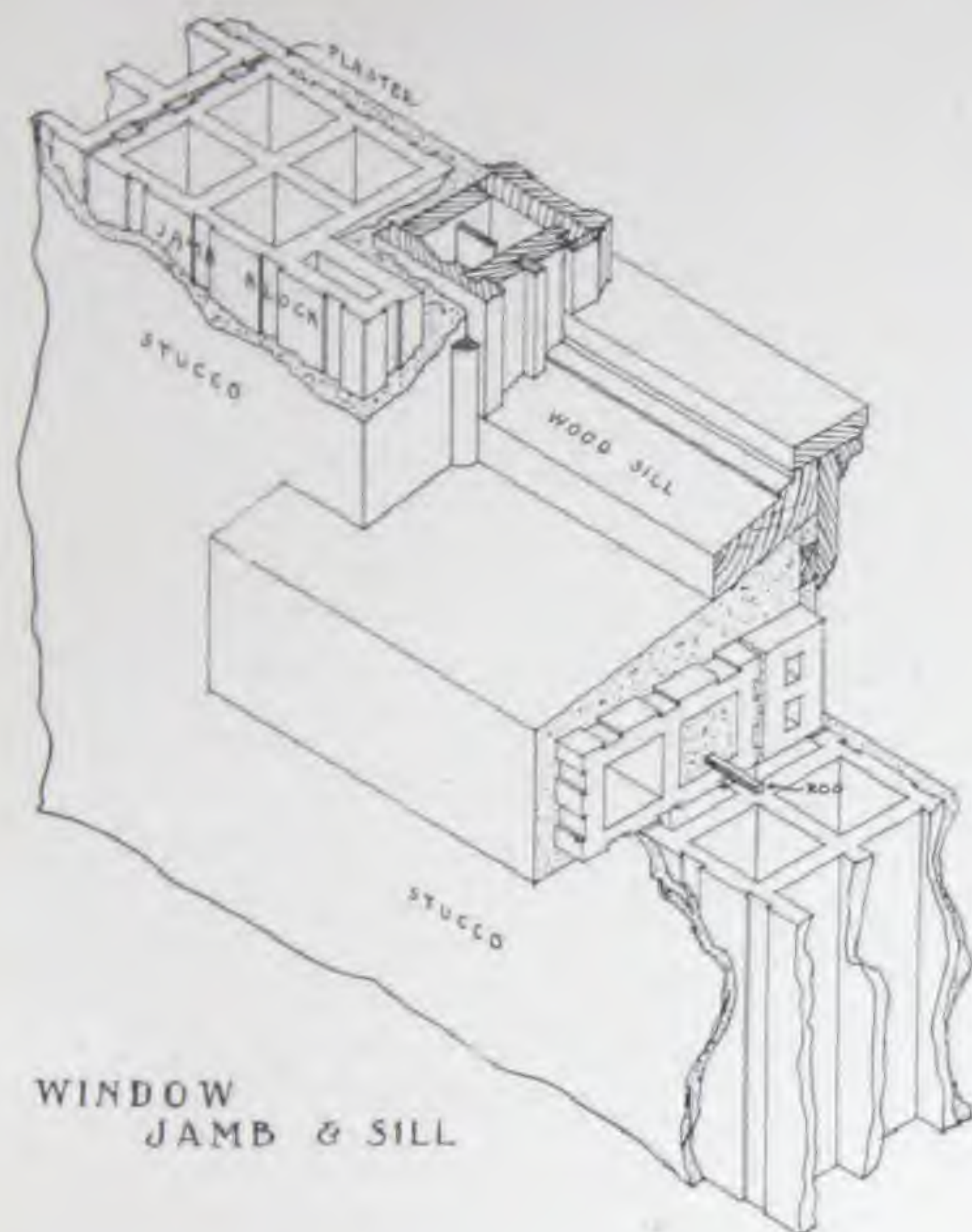
In addition to the arch lintel shown on previous pages and the reinforced lintel shown on the following page, the above forms are frequently used.

NATCO-HOLLOW-TILE

NATIONAL FIRE PROOFING COMPANY



INCORPORATED 1908



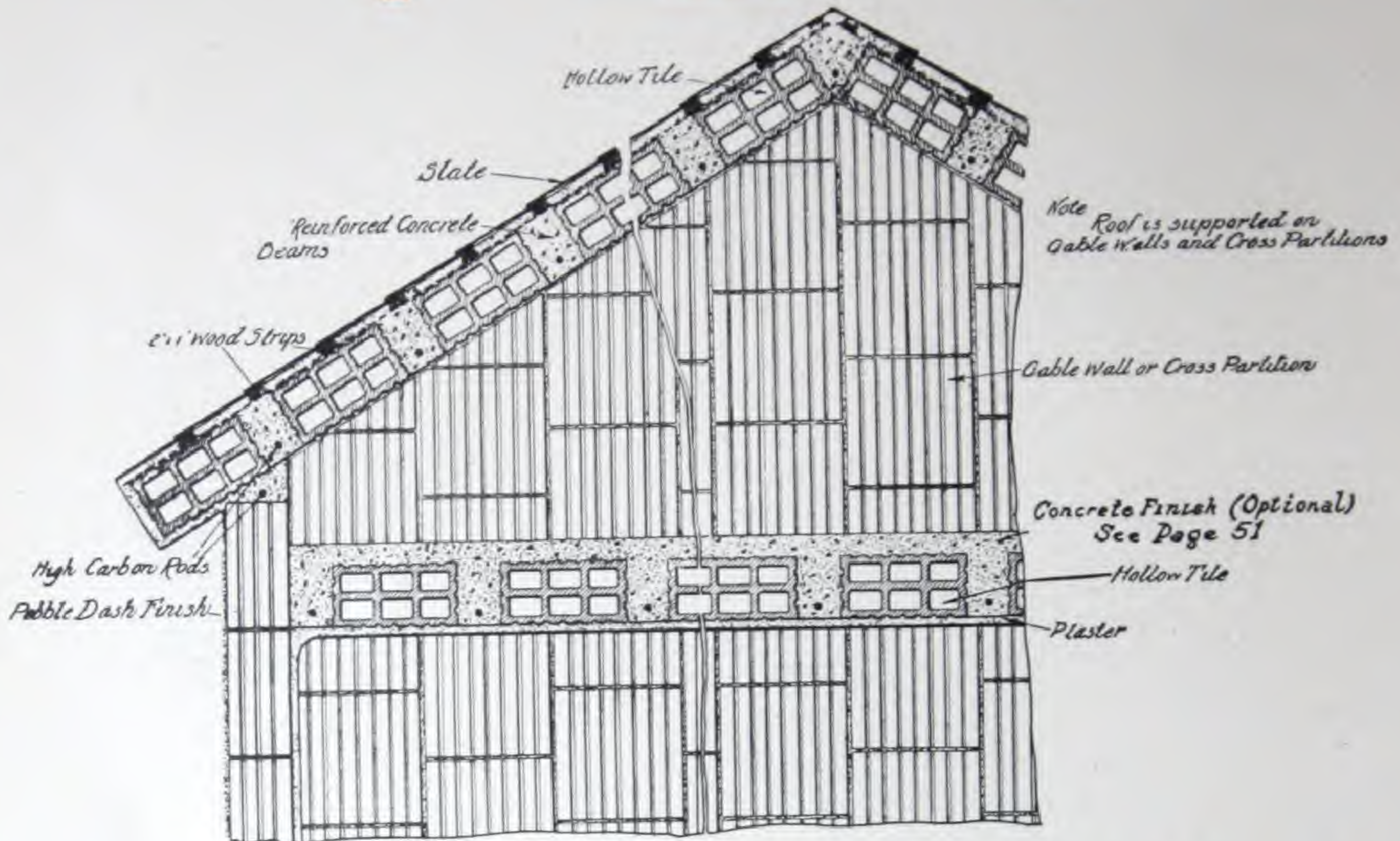
Working details of Natco Hollow Tile construction, as used in a residence illustrated on Page 43, designed by Dillon, McClellan & Beadel, Architects, New York.

NATCO HOLLOW TILE

NATIONAL FIRE PROOFING · COMPANY ·



ORGANIZED 1888



Detail of Roof & Floor Construction

One of the difficulties which has appeared in the building of fireproof houses at moderate cost has been the securing of satisfactory roof construction. The problem has been to design a pitched or gable roof without the use of structural steel members. A flat fireproof roof could be readily designed without structural steel, but it would not be satisfactory to the architectural taste of all persons. The pitched roof using structural steel would considerably increase the cost of the building.

The plan shown above solves this problem most satisfactorily. It will be seen that the roof is of reinforced fireproof Natco Hollow Tile construction similar to the floor construction shown on Page 77. This construction bears on the end or gable walls of the building and on cross partitions of tile built up solidly from the floor immediately below the roof. The entire roof load, therefore, is carried by the gable walls and cross partitions, and there is no load to act as a thrust on the side walls.

By the insertion of nailing strips or sleepers, as shown above, the finished roof either of slate, tile or composition, as may be desired, is readily laid.

NATCO · HOLLOW · TILE

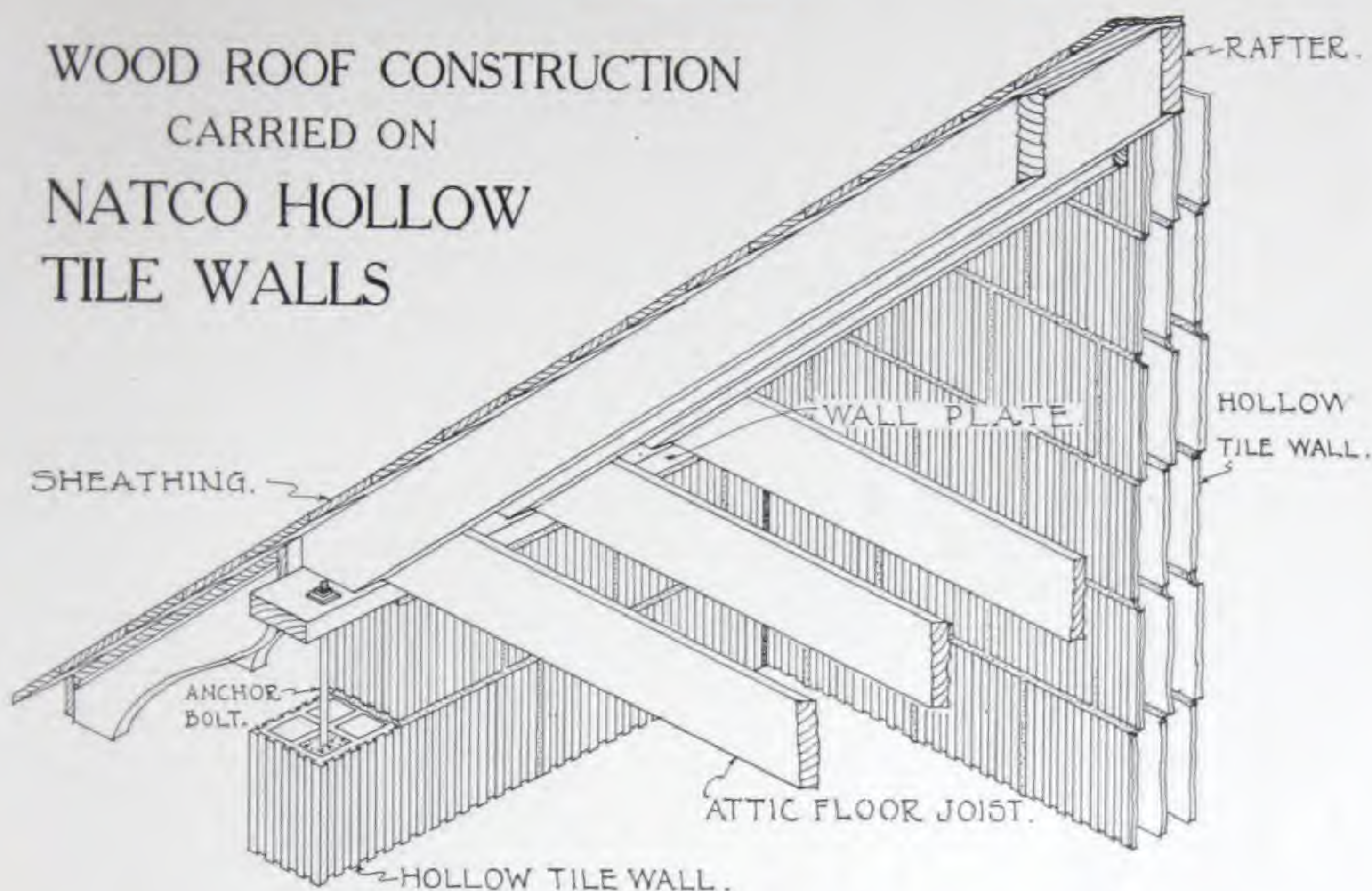
NATIONAL FIRE PROOFING · COMPANY ·



ESTABLISHED 1898



WOOD ROOF CONSTRUCTION CARRIED ON NATCO HOLLOW TILE WALLS

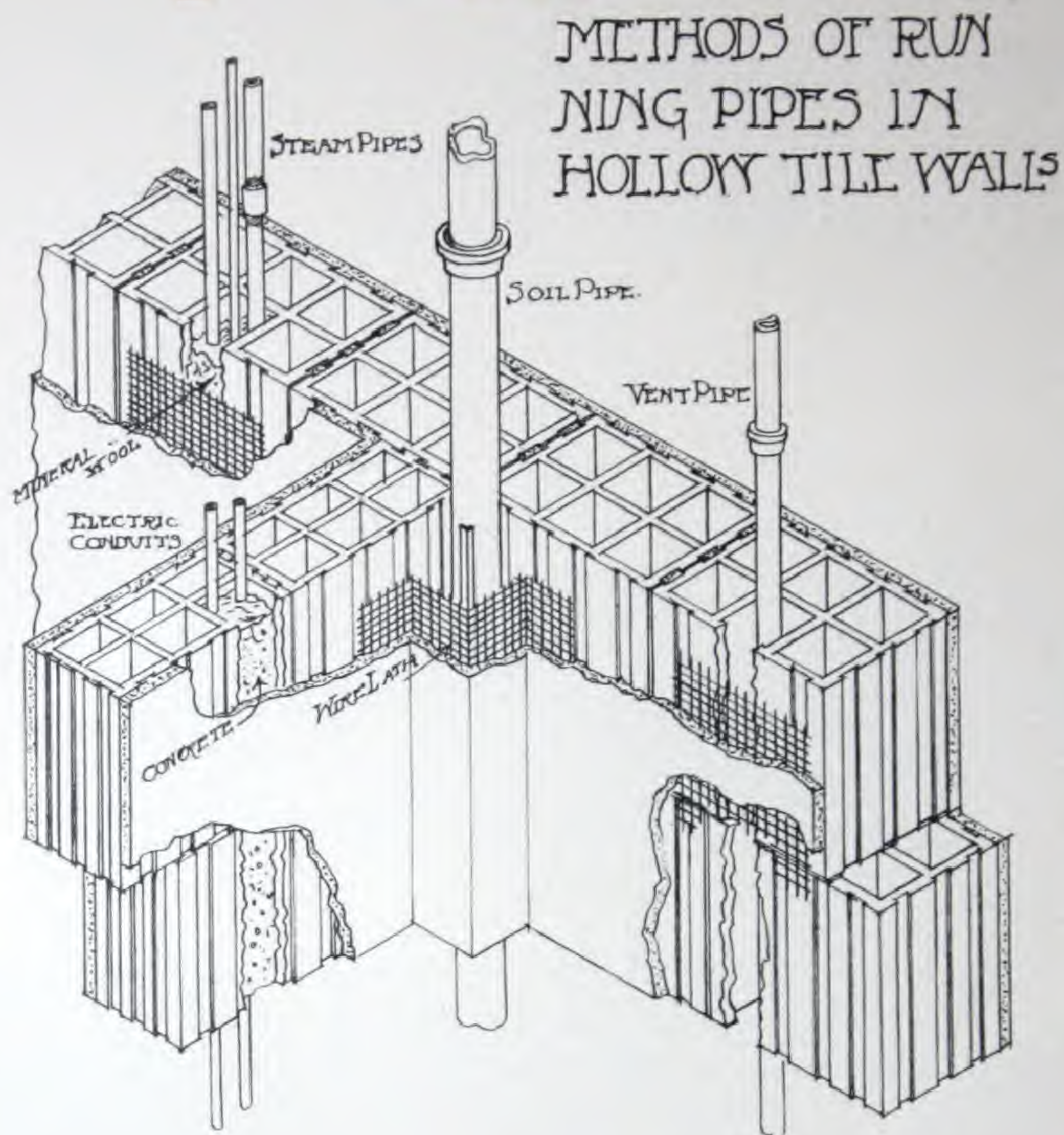


Note the method of anchoring the roof plate to the tile, also the method of carrying the wooden joists on the roof plate and bolting them to the roof timbers.

The anchor bolt should be about 30 inches long and spaced about 5 foot center to center. There should be a plate or hook at the lower end, the entire length of which should be embedded in cement mortar.

Joists and rafters should be well spiked to each other and also to the roof plate.

NATCO HOLLOW TILE



The above cut shows the method of running pipes in Natco Hollow Tile walls. By breaking into one cell of the block, the steam pipes, electric conduits, and vent pipes can be concealed there, covered with mineral wool, or concrete, and metal lath on the inside face of the block. Owing to their large size, where sewer pipes are carried, it is well to form a box in the corner where the partition runs into the wall, as shown in the drawing.

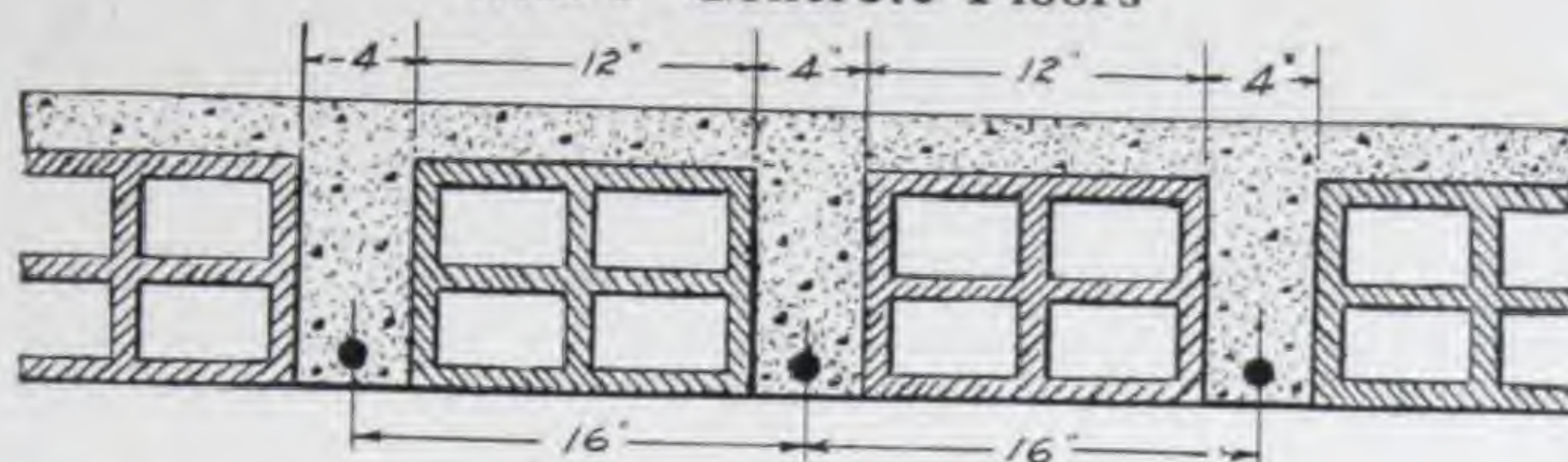
NATIONAL FIRE PROOFING COMPANY



ORGANIZED 1889



SAFE LIVE LOADS in Lbs. per sq. ft. for COMBINATION TILE FLOOR with 2" Concrete Floors



Composition of Concrete: 1 Part Portland Cement—2 Parts Sand—4 Parts Stone or Gravel.
Factor of Safety—4.

SIZE OF TILE

Span	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.	15 in.
5'-0"	665	.....	.....	.....	.....	.....	.....	.....	.....
6'-0"	446	660	.....	.....	.....	.....	.....	.....	.....
7'-0"	314	470	655	.....	.....	.....	.....	.....	.....
8'-0"	229	347	487	650	.....	.....	.....	.....	.....
9'-0"	170	263	372	499	645	.....	.....	.....	.....
10'-0"	128	202	290	392	509	640	.....	.....	.....
11'-0"	97	157	229	313	408	515	635	.....	.....
12'-0"	74	123	183	252	332	421	521	.....	.....
13'-0"	55	97	147	205	272	348	432	625	.....
14'-0"	41	76	118	168	225	289	361	526	.....
15'-0"	29	59	95	138	187	242	304	447	.....
16'-0"	.....	45	77	113	156	204	258	381	610
17'-0"	.....	34	60	93	130	172	220	328	527
18'-0"	.....	.....	48	76	108	145	187	283	459
19'-0"	.....	.....	37	61	90	123	159	245	402
20'-0"	.....	.....	.....	49	74	103	136	212	352
21'-0"	.....	.....	.....	38	61	86	116	184	310
22'-0"	.....	.....	.....	.....	49	72	98	159	272
23'-0"	.....	.....	.....	.....	39	60	83	138	240
24'-0"	.....	.....	.....	.....	30	49	70	119	212
Reinforced Steel	$\frac{5}{8}$ " sq.	$\frac{11}{16}$ " sq.	$\frac{3}{4}$ " sq.	$\frac{13}{16}$ " sq.	$\frac{7}{8}$ " sq.	$\frac{15}{16}$ " sq.	$\frac{15}{16}$ " sq.	$1\frac{1}{16}$ " sq.	$1\frac{3}{8}$ " sq.
Wt. of Floor Per Square Foot	50 lbs.	55 lbs.	60 lbs.	65 lbs.	70 lbs.	75 lbs.	80 lbs.	90 lbs.	105 lbs.

Above tables are figured for continuous span with the following stresses, which are very conservative:
500 pounds per square inch, extreme fiber composition in concrete.

16,000 pounds per square inch, tension in steel, (to be medium open hearth).

The end sheave and longitudinal sheave should be investigated, and sheave reinforcement provided when necessary.

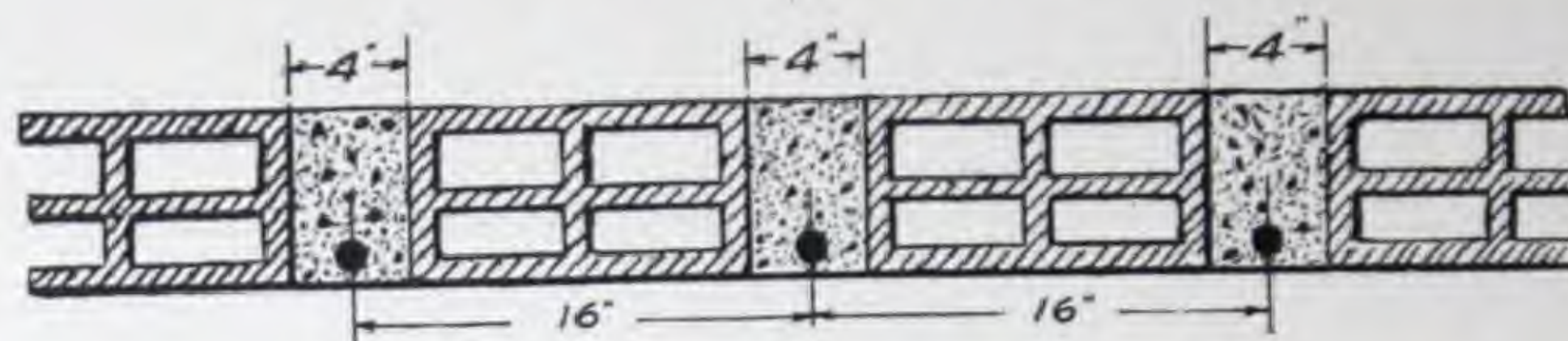
NOTE—Designs made in accordance with the above table of loads will conform with the building laws of most large cities. However a more economical design may often be obtained where building laws permit higher stresses.

Our Engineering Dept. is at the entire disposal of anyone desiring further information.

NATCO·HOLLOW·TILE

SAFE LIVE LOADS

in lbs. per sq. ft. for
COMBINATION TILE FLOOR
 without Concrete Top



Composition of Concrete: 1 part Portland Cement—2 parts Sand—4 parts Stone or Gravel.
 Factor of Safety, 4.

SIZE OF TILE.

Span	4"	5"	6"	7"	8"	9"	10"	12"	15"
5'-0"	82	162	262	388	540	...	...	...	...
6'-0"	49	103	170	257	360	482	...	...	...
7'-0"	29	68	115	177	252	340	438	...	...
8'-0"	..	45	79	125	181	248	322	499	...
9'-0"	..	29	54	90	133	185	242	380	...
10'-0"	..	..	37	65	99	140	185	295	506
11'-0"	..	..	24	46	73	106	143	232	404
12'-0"	..	..	..	32	54	81	110	184	326
13'-0"	..	..	..	..	39	61	86	146	266
14'-0"	..	..	..	..	27	46	66	117	218
15'-0"	..	..	..	..	..	33	50	93	179
16'-0"	..	..	..	..	..	..	37	74	148
17'-0"	..	..	..	..	..	..	26	57	121
18'-0"	..	..	..	..	..	..	..	44	99
19'-0"	..	..	..	..	..	..	..	32	81
20'-0"	..	..	..	..	..	..	..	22	65
Reinforced Steel in Each Rib	$\frac{3}{8}$ " Sq.	$\frac{3}{8}$ " Sq.	$\frac{7}{16}$ " Sq.	$\frac{1}{2}$ " Sq.	$\frac{1}{2}$ " Sq.	$\frac{9}{16}$ " Sq.	$\frac{9}{16}$ " Sq.	$\frac{5}{8}$ " Sq.	$\frac{3}{4}$ " Sq.
Weight of Floor per Square Foot	26 lbs.	30 lbs.	38 lbs.	43 lbs.	48 lbs.	52 lbs.	58 lbs.	68 lbs.	82 lbs.

Above tables are figured for continuous spans with the following stresses, which are very conservative:
 500 lbs. per square inch extreme fibre compression in concrete.
 16000 lbs. per square inch tension in steel (to be medium open-hearth).
 Tile acting in compression as per Nat. F. P. Co. formula.

NATIONAL FIRE-PROOFING COMPANY

ORGANIZED 1887

LOAD TABLE OF JOHNSON SYSTEM FLOOR

Without Cement Top Finish

Safe Live Load in Pounds per Square Foot—Factor of Safety, 4.

Span in Feet	12-in. Tile. $\frac{1}{8}$ -in. Dia. Rod. Weight of Floor per sq. ft., 55 lbs.	10-in. Tile. $\frac{1}{8}$ -in. Dia. Rod. Weight of Floor per sq. ft., 52 lbs.	9-in. Tile. $\frac{1}{8}$ -in. Dia. Rod. Weight of Floor per sq. ft., 48 lbs.	8-in. Tile. $\frac{1}{8}$ -in. Dia. Rod. Weight of Floor per sq. ft., 45 lbs.	7-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 42 lbs.	6-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 37 lbs.	5-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 35 lbs.	4-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 29 lbs.	3-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 27 lbs.
8	...	...	488	422	324	263	171	125	79
9	...	507	383	333	254	206	132	113	61
10	558	407	308	264	202	163	105	76	48
11	458	337	253	219	165	133	86	62	39
12	386	282	210	179	137	111	71	51	32
13	326	234	178	152	116	93	59	43	...
14	278	202	152	129	98	78	49	36	...
15	241	175	130	111	84	68	42	30	...
16	210	151	113	97	73	58	36	...	...
17	189	133	99	75	63	51	31	...	...
18	164	117	87	72	56	45	...	...	...
19	146	103	77	66	49	39	...	...	...
20	129	92	68	58	43	34	...	...	...
21	117	83	61	51	38	30	...	...	...
22	104	75	54	46	34	...	...	...	...
23	95	67	49	41	30	...	...	...	...
24	86	61	44	37	...	...	...	...	...
25	77	55	39	...	...	...	...	...	...

With Two Inch Cement Top Finish

Safe Live Load in Pounds per Square Foot—Factor of Safety, 4.

Span in Feet	12-in. Tile. $\frac{1}{8}$ -in. Dia. Rod. Weight of Floor per sq. ft., 79 lbs.	10-in. Tile. $\frac{1}{8}$ -in. Dia. Rod. Weight of Floor per sq. ft., 77 lbs.	9-in. Tile. $\frac{1}{8}$ -in. Dia. Rod. Weight of Floor per sq. ft., 72 lbs.	8-in. Tile. $\frac{1}{8}$ -in. Dia. Rod. Weight of Floor per sq. ft., 69 lbs.	7-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 66 lbs.	6-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 62 lbs.	5-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 59 lbs.	4-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 54 lbs.	3-in. Tile. $\frac{1}{4}$ -in. Dia. Rod. Weight of Floor per sq. ft., 51 lbs.
8	...	...	...	...	...	...	...	567	437
9	...	...	...	...	...	...	568	442	342
10	...	...	...	...	...	530	435	354	272
11	...	...	...	...	514	435	355	292	224
12	...	...	572	508	429	365	298	242	187
13	...	568	487	428	364	310	255	204	157
14	...	491	417	368	311	265	215	174	133
15	540	421	362	318	269	230	185	151	115
16	470	368	317	278	236	200	162	132	100
17	415	326	277	243	207	175	142	114	86
18	368	287	245	215	182	155	125	100	76
19	325	251	219	190	161	137	110	89	67
20	292	228	195	170	146	121	98	78	59
21	265	206	175	153	129	108	88	70	52
22	238	185	160	139	116	97	78	63	...
23	218	168	143	125	105	88	70	27	...
24	196	153	130	114	95	80	63	...	...
25	178	138	118	103	86	72	58	...	...

NOTE—Attention is called to the fact that this construction is reinforced in both directions. The reinforcing rods (shown in detail drawing page 79) take the direct strains. The transverse strains are taken by a woven metal fabric running lengthwise of the arch and through this fabric the rods are interwoven at intervals of four inches.

The above table is approximate and should be used for estimating only.

NATCO·HOLLOW·TILE

Load-carrying capacity of dense hard burned Natco Hollow Tile, as used in houses illustrated in this volume for exterior walls and interior bearing partitions.

Size of Tile	Width of Wall 1 Tile Thick	Ultimate Load per Lineal Foot of Wall in Pounds	Width of Wall 2 Tiles Thick	Ultimate Load per Lineal Foot of Wall in Pounds
4" x 12" x 12"	4"	114,201	8"	228,402
6" x 12" x 12"	6"	142,862	12"	285,724
8" x 12" x 12"	8"	202,131	16"	404,262
10" x 12" x 12"	10"	228,226	20"	456,452
12" x 12" x 12"	12"	259,300	24"	518,600

For official report of test showing ultimate load carrying capacity of blocks see the following letter.

**Columbia University
in the City of New York**

DEPARTMENT OF CIVIL ENGINEERING

TESTING LABORATORY.

April 27, 1910.

National Fireproofing Co.,
B'way & 23rd St.,
New York, N. Y.

Gentlemen:

At the request of Mr. John A. Seaton, Superintendent of Buildings, Borough of Richmond, New York City, I have made a number of compression tests upon several sizes of your hollow wall tile.

These tile were selected in the Boro of Richmond by Mr. Harry Brown, Inspector of Buildings, regardless of defects. In each size submitted medium, hard and dense burn blocks were represented.

The tests were made upon an Olsen testing machine of 400,000 lbs. capacity, and the specimens were faced with cement in order to obtain a uniform bearing on the whole compressed surface. It was noted, however, upon removal of the specimens from the testing machine that in some instances the cement had compressed locally, and thus caused an uneven distribution of loading.

Three sizes of blocks, shown in the accompanying sketches, were tested, and ten tests were made upon each size.

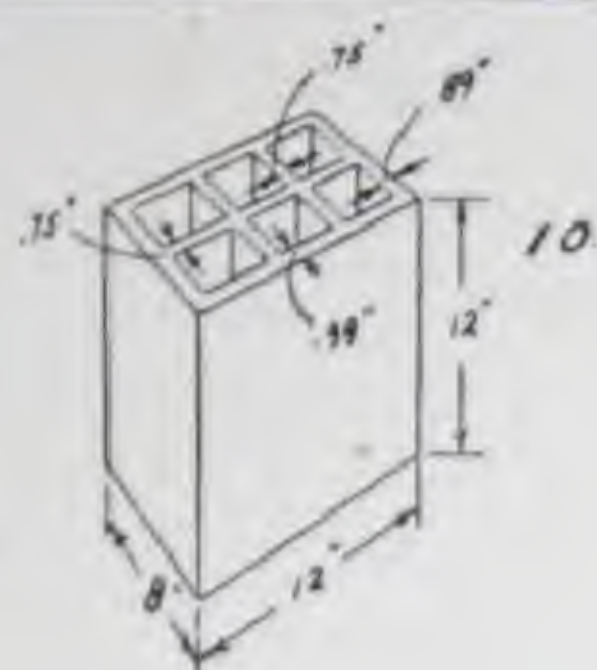
The following log gives the average results obtained:

Shape and
Nominal size
of block.

No. of
samples.

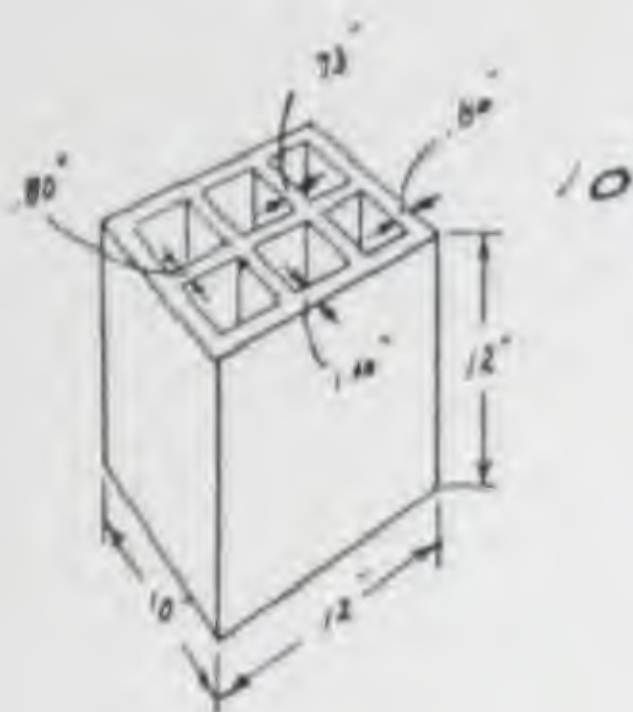
Average
maximum
load.

Average
compression
Strength the # per
sq. inch on net
section.



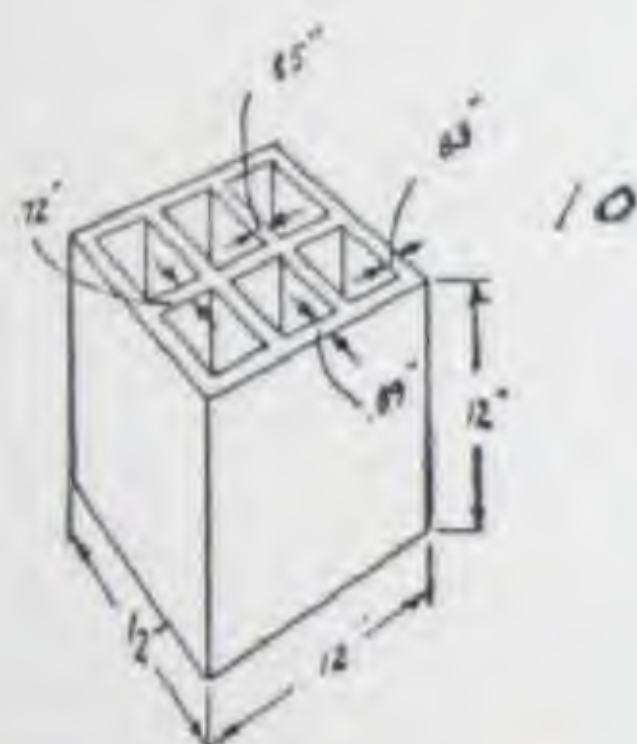
174816

3826



250344

4855



242290

4589

The tests were witnessed by Inspectors Harry Brown and J. Moore, Boro of Richmond; Chief Inspector Ludwig and Engineer A. Swartz, Boro of Manhattan, and Inspector Daniel Campbell, Boro of Queens.

Respectfully submitted,

Ina H. Woolson
per E. B. Maynard

SPECIFICATION SHEET

for

Erecting Natco Hollow Tile.

GENERAL:—

Provide and erect all the Natco Hollow Tile exterior walls, for interior bearing partitions, subdividing partitions, etc., as shown on the plans. All material must be hard burned, true and regular in size and shall have all faces scored with special dove-tail scoring to offer a good surface for the stucco finish. Blocks badly cracked or broken on the outside shells will not be acceptable under this specification. In general the terra cotta blocks must be Natco Hollow Tile manufactured only by the National Fire Proofing Company.

LAYING:—

All blocks used in the exterior walls and interior bearing partitions, must be laid with the holes or cores vertically in the wall, in order to develop their full strength. Interior subdividing partitions may be laid on the side if desired.

MORTAR:—

All mortar used for laying up the Terra Cotta Blocks shall consist of a standard Portland cement and clean sharp sand in the proportion of one part cement to three parts sand, well mixed to a smooth, moderately stiff mortar. Lime, well slaked and not to exceed 10 per cent of the cement, by volume, will be allowed in the mortar.

FOUNDATION WALLS:—

Where so indicated on plans, the foundation walls from top of footings to the underside of the first floor beams should be constructed 12 x 12 x 12 Natco Hollow Tile Blocks. Care should be taken at the corners to use 6 x 12 x 12 blocks to secure a running bond in the wall.

Where columns or piers supporting heavy loads rest on the foundation wall the same will be filled with concrete from footing to top of wall to prevent the possibility of failure due to compression.

EXTERIOR WALLS AND BEARING PARTITIONS:—

Exterior walls and partitions will be of thickness shown on the plans and must be in accordance with the foregoing conditions of quality, etc.

SUBDIVIDING PARTITIONS:—

Sub-dividing partitions will be of hard burned Terra Cotta Blocks. All partitions must be started on the structural floor and wedged against the floor arch above.

JAMB BLOCKS:—

Provide for all hung windows, special Jamb Blocks with rabbetted opening, to receive the window frame box. Fill well with mortar the space between the blocks and the frame box to prevent the passage of air or moisture through same.

LINTELS:—

Construct the lintels over all openings with special Lintel Blocks, either with arch blocks, or with Wall Blocks reinforced with steel bars and concrete, as per detail shown on plans. Care must be taken not to bulge the lintels outward when placing the concrete.

SILLS:—

Form all sills of 4 inch Natco Hollow Tile laid on the side, with a slight tilt so as to shed water. Care must be taken to fill all joints so as to prevent moisture working through the same.

ARCH OPENINGS:—

Build all arched openings shown as brick on the plans of two course rowlock common or hollow brick header arches, carefully laid on substantial centers. Arches will spring from the Terra Cotta Block and must be well bedded on same. Arches of approximately 3 feet inner radius may be constructed of keys as used for flat arch lintels.

PORCH COLUMNS AND PIERS:—

Construct the porch columns and piers, sizes as shown, of Hollow Terra Cotta Blocks. Where column finish is round, build same of 3 inch round Hollow Terra Cotta column covering, filling the same with concrete where the second story walls are supported by them. When columns are filled with concrete, they should be wired before pouring. Square columns will be built of the proper size wall tile.

FLOOR BEAM BEARINGS:—

Provide and set terra cotta slabs 1 inch thick under all floor beams as bearing plates for same. These slabs will also be used for working up to levels and story heights when the full or fractional blocks do not work out correctly.

ROOF PLATES:—

Embed at intervals of five feet in the wall under the roof plate, three-quarter inch bolts 30 inches long with nut and washers and projecting 6 inches above the top of wall, to allow of the plate being fastened down. Fill around bolts with cement grout before placing roof plate.

Floor Construction

GENERAL:—

Floor construction will be of the type known as the Combination Hollow Tile and concrete floor slab construction, consisting generally of 4 inch reinforced concrete beams spaced 16 inches on centers with Hollow Tile Blocks between, all to have at least 4 inch bearing on walls.

CONCRETE:—

All concrete used in floor arches will consist of one part Portland cement, two parts clean sharp sand, and four parts broken stone or gravel of such size as will pass through a three-quarter inch ring. Concrete will be of wet mixture and must be well tamped and worked around reinforcing steel after pouring.

REINFORCING STEEL:—

Steel rods for floor construction must be of such type as will offer a mechanical bond with the concrete. Corrugated, twisted or similar type will be acceptable. Steel must have an elastic limit of not less than one-half the tensile strength. Rods must be clean and free from rust scales before placing in position and must be placed not over 1 inch above bottom of floor.

TILE:—

Depth of tile filler blocks will be regulated by span and load to be carried and will be of size indicated on the plans. All blocks will be wet before concrete is placed so as to insure a good bond with the concrete.

CENTERS:—

Centers must be of such size to insure of their not deflecting under the weight of the wet concrete, and must be provided in such quantity as to insure of speedy work. Care must be taken not to remove the centers before the concrete is hard, and under long spans a center line of supports must be maintained for at least three weeks after the concrete has been poured. In cold weather the centers must be left in place until directed by the Architect to remove them.

Specification Sheet for Stucco

STUCCO FINISH:—

Stucco work will be two coat throughout. Tile to be thoroughly wet before applying first coat of stucco. Scratch coat will be at least one-half inch thick outside of tile surface, and will consist of one part Portland cement, three parts sand, with not more than 10 per cent lime putty. First coat will be applied under pressure and must be well scratched before it sets. Finish coat will be one-quarter inch thick and for cement color finish will consist of one part cement and two parts clean sand.

MEMORANDUM AND GENERAL INFORMATION:—

For white finish use white cement and white sand or marble dust. Buff or yellow finish may be secured by the use of yellow ochre. Lamp black added to the cement and sand will provide a dark tone if desired.

In the use of any coloring material, be sure to use only the best mineral pigments. For a rough sand finish the float is covered with burlap and finish coat should be quite dry. Dash finish is secured by throwing the mortar for the second coat on the walls with a wooden paddle. For pebble dash finish, the mortar should be rather wet when placed on the wall, after which the pebbles are thrown against it.

Stucco may be made waterproof by the addition of one of the many damp-proofing compounds now found on the market.

Careful mixing and workmanship will insure a good finished work. In warm weather precautions must be taken to prevent the stucco drying out too quickly. This may be prevented by spraying the walls once or twice a day for several days after applying the finish coat.

COMPARISON OF COSTS

The question of cost of construction is usually a controlling factor with the prospective house builder. This is equally true whether he builds as an investment or to secure a home.

Few builders realize, however, that variations in the cost of different houses are caused chiefly by differences in what may be termed the "superficial parts" of the building.

The point involved is simply this: Jones and Smith both desire a brick walled, stone front house of exactly the same size, same ground area, same height, same number of floors, same dimensions as to width and length, same number of rooms arranged in the same manner.

So far, both using the same quality of materials and the same amount of labor, it is evident that the cost of both houses will be practically equal *for the basic structure*, i. e., the foundations, walls, floors, roofs and partitions. It is also apparent that up to this point one house is exactly the same as the other.

Now they part company. Jones wants mahogany wood work throughout. Smith is happy with birch. Jones wants several stained glass windows; Smith is willing to have clear glass throughout. Jones wants library walls of burlap with painted decorative panels; Smith is satisfied with a tinted plaster wall, etc., etc. The result is that Jones' house complete costs, say, fifty thousand dollars, and Smith's costs only ten thousand. Yet both buildings, so far as their actual structural parts are concerned, are exactly identical and cost the same amount.

In connection with fireproof construction, these points are especially appropriate. The cost of Natco Hollow Tile is the same whether used for the millionaire's residence or for the clerk's. The cost per square foot to set it is the same. The one building can readily be made as durable, substantial and free from fire danger as the other.

Only where the dimensions and the "superficial parts" of the building are different, does the necessity arise for the need of the longer purse.

The figures given below, which are, of course, purely approximate, are of interest in this connection.

Comparative building costs of different systems of building, based upon an average frame dwelling costing \$10,000.00 complete, located in the vicinity of New York:

- (a) \$10,000 Frame.
- (b) \$11,000 Brick outside walls, wooden inside.
- (c) \$10,800 Brick outside walls, backed up with Natco Hollow Tile.
- (d) \$10,250 Stucco on expanded metal, wooden inside.
- (e) \$10,500 Natco Hollow Tile, stuccoed, wooden inside.
- (f) \$12,000 Natco Hollow Tile stuccoed—fireproof throughout except roof.
- (g) \$14,000 Natco Hollow Tile walls faced with brick, fireproof floors and roof.
- (h) \$15,000 Brick walls—fireproof floors and roof.

The above figures are based on an average taken from two architects and two builders, who have had experience with the methods of construction designated.

Our experts are at the service of the profession for consultation with regard to any or all details of construction.

We are glad to freely offer this service to Architects and Contractors as a means of furthering safe and economical methods for the use of our material.

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